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MEXICAN MOLLUSKS COLLECTED FOR DR. BRYANT WALKER IN 1926

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PART II. AURICULIDAE, ORTHURETHRA, HETERURETHRA, AND AULACOPODA

THIS is the second of a series of papers on a collection of Mexican land and fresh-water mollusks made for Dr. Bryant Walker during the summer of 1926. The first is number 193 of the *Occasional Papers* (1928); it includes the introduction, habitat notes, and first systematic part (terrestrial operculates). In the present part, the abbreviation ANSP. is used to designate the Academy of Natural Sciences of Philadelphia, on account of the frequent references to its mollusk collections.

In the Pupillidae, *Pupisoma comicolense* is described as new. In the Endodontidae, a key to the North American species of *Punctum* is given, and *P. vitreum* (type locality in Texas), *Rotadiscus hermanni nivatus,* and *Radiodiscus proameri* are described as new. In the Philomycidae, the anatomy of *Pallifera costaricensis alticola* (new) and *P. costaricensis crosseana* (S. und P.) is described and the possible specific identity of all the tropical American "species" is discussed. In the Zonitidae, *Guppya sterkii punctum* and a

subgenus of *Mesomphix, Omphalinella,* with type by original designation *Helix veracruzensis* Pfr., are new. A key to the subdivisions of *Mesomphix* (including *Omphalina*) is given and the anatomy of *M. lucubratus, M. bilineatus, M. veracruzensis,* and *M. carinatus* is discussed. Dissections of *Helix kawaiensis* Pfr. from the Hawaiian Islands show that it is a form of *Helix minuscula* Binn.; as a result, *Pseudovitrea* becomes a synonym of *Hawaiia.* Anatomical data (as well as the shell) prove that *Striatura meridionalis* (from Mexico to Pennsylvania) and *S. pugetensis* (from Washington) belong in the subgenus *Pseudohyalina* and are not closely related to *S. milium* (northeastern U. S.). Two species of Systrophiidae are reported. Four species of European Limacidae are recorded, and the anatomy (Mexico and United States) and synonymy (central American) of the palearctic *Deroceras laeve* (+ *Agriolimax campestris*) are discussed. Types are in collection of Dr. Bryant Walker, except that of *Punctum vitreum,* which is in Academy of Natural Sciences of Philadelphia.

Auriculidae

Carychium exiguum mexicanum Pilsbry

Type locality: Orizaba, Vera Cruz, Mex. ABCD, III, a, 4, 33–35, 37, 41, 52–54; Córdoba, 2700 ft., rare; Necaxa, 2625–5500 ft., under leaves, the commonest small snail.

Strobilopsidae

Strobilops aenea mexicana Pilsbry

Type locality: Diente, near Monterey, Nuevo Léon. ABCD, III, bc, 4, 24, 32, 35, 38, 52, 53; Córdoba, 2700 ft.; Necaxa, 3000–5400 ft., mainly on rotting wood, but also on rock faces.

The genitalia of several specimens examined were without terminal male organs.

Pupillidae

Pupisoma dioscoricola insigne Pilsbry

Type locality: Brownsville, Texas. D, III, e, 53, 55; Necaxa, 2215–3000 ft., very rare.

Pupisoma comicolense, new species

Plate 7, figs. 1, 2

P. comicolense H. B. B. (1927, Proc. Acad. Nat. Sci. Philadelphia 79: 224, pl. 15, f. 4–7), anatomy only.

Type locality: Necaxa, station 53. AD, III, de, 24, 52–54; Necaxa, 2625–3800 ft.; mainly below the falls, common on leaves of shrubs and trees.

Shell (figs. 1, 2): small, turbinate; epidermis light brownish with a satin luster. Whorls: 4½, globose; suture well impressed; last whorl descending. Embryonic whorls: 1¾ to 2, darker in color than later ones; decorated with minute, raised tessellation, which gives surface the appearance of fine-grained leather; growth-wrinkles emerge near end of second whorl. Later whorls: growth-wrinkles weak and low over most of shell, but slightly intensified at suture, giving latter a puckered appearance (occasional specimens develop a few higher riblets); entire surface vermiculate-granose, without definite spirals. Umbilicus: small, rimate (about 14 times in maj. diam.). Aperture: well rounded and oblique (about 40° to long axis of shell). Peristome: very weakly expanded in basal and palatal regions and weakly arcuate in latter; broadly reflected in columellar, so that half of umbilicus is hidden.

Dimensions

	Shell			Aperture		Whorls
	alt.	maj. diam.	min. diam.	alt.	diam.	
Type	2.19	85(1.87)	80(1.76)	46(1.00)	96(.96)	4½

P. comicolense is about the size of *P. dioscoricola* (C. B. A.), but with one more whorl is relatively and actually higher. Its sculpture is most like that in *P. minus* Pilsbry, but *P. comicolense* is far larger and has a relatively much smaller umbilicus and higher whorls with better impressed suture. Although it occurs with *P. mediamericanum,* the latter is most abundant in lower vegetation and at higher altitudes.

Pupisoma mediamericanum Pilsbry

P. mediamericanum H. B. B. (1927: 223, pl. 15, f. 1–3), anatomy of Necaxa examples.

Type locality: 500 ft. above Orizaba, V. C. ABCD, III, ad, 3, 6, 33, 35, 37, 41, 53; Peñuela and Sumidero (2625–3400 ft.); Necaxa, 3000–5500 ft.; common at one or two localities above Necaxa Falls, mainly on low vegetation, shrubs, and vines, but also rarely on ground.

The Necaxa shells attain ½ whorl more than the type specimen; this produces larger and slightly more slender shells, which are quite variable in this last feature; some specimens are very noticeably more elongate than the type. The umbilicus is elliptical; in the wider (A) of the two specimens for which the dimensions are given, the maj. diam. of the umbilicus goes 5.5 times and the min. diam. 9.2 times in the maj. diam. of the shell; while in the narrower (B), the respective proportion are 6.2 and 10.3.

	Dimensions					
Type	1.7	85(1.44)	.....	41(1.7)	.....	4½
Necaxa shells,						
A.	2.02	81(1.63)	.....	40(.81)	89(.72)	5
B.	1.88	74(1.39)	.....	39(.74)	95(.70)	5

Pupisoma sp?

Above Necaxa: C, I, d, 37; one peculiarly elongate specimen that is not referable to any known species.

Bothriopupa sp?

Necaxa, 3120 ft.; D, I, a, 52; a single, immature specimen that appears to belong to this genus.

Gastrocopta (*Albinula*) *contracta contracta* (Say)

Type locality: Occoquan, Va. BCD, III, abc, 34, 35, 52, 53; Necaxa, 3000–5000 ft.; infrequent, mainly on rock outcrops.

Gastrocopta (*Vertigopsis*) *pentodon* (Say)

Type locality: Pennsylvania. BCD, III, abc, 34, 35, 53; Necaxa, 3000–5000 ft.; usually with preceding.

SUCCINEIDAE

Succinea avara Say

Type locality: "Northwest Territory." E, III, a, 13, 61; San Juan Teotihuacán and San Ignacio, Yucatan; 7510 ft. and sea level.

The Yucatan specimens are plainly this species, although they approach the form *vermeta*. The identification of the single shell from the pyramids is more dubious.

Succinea virgata Martens and form *microspira* Fischer et Crosse

Type locality: Vera Cruz. BCD, III, ab, 23, 33–35, 51, 52, 55; Necaxa, 2215–5000 ft.

This variable species is most frequent on wet cliffs, but occurs sparingly in other habitats.

ENDODONTIDAE

Punctum minutissimum (Lea)

Type locality: Cincinnati, Ohio. BCD, III, a, 33–35, 41, 53, 54; Necaxa, 2625–5000 ft.; apparently infrequent.

These Necaxa specimens agree very well with those from eastern United States. However, *P. minutissimum* is quite distinct from the European *P. pygmaeum* (Drap.); specimens of the latter from the Draparnaud collection, collected at Lyons, France, are in the Academy of Natural Sciences of Philadelphia (ANSP. 47933). Peculiarly enough, although Morse (1864, *Jour. Portland Soc. Nat. Hist.* I: 28, f. 69, 72) clearly pointed out the differences between the two species, his paper is usually quoted as proof of their identity.

The following table of dimensions is founded on large specimens with 4¼ whorls (ANSP. numbers after species names), excepting the measurements of the subspecies of *conspectum* which are copied. A key to the North American species of *Punctum* (also *P. pygmaeum*) is appended.

Dimensions

		Shell		Umb. in maj. diam.	Whorls
P. californicum (13804) San Bernardino Mts., Cal. (high shell)	1.25	137 (1.71)	126 (1.58)	5	4¼
P. randolphii (111415) Clackamas Co., Oregon	.73	147 (1.07)	137 (1.00)	5	4¼
P. pygmaeum (47933) Lyons, France (Draparnaud coll.)	.85	177 (1.50)	161 (1.37)	3.75	4¼
P. minutissimum, Necaxa, Mexico (station 53)	.77	163 (1.19)	143 (1.10)	3.56	4¼
(46182) Beaver Co., Pa. (low)	.69	167 (1.15)	158 (1.09)	3.08	4¼
(116824) Stevenson, Ala. (biggest)	.94	161 (1.51)	148 (1.39)	3.96	4¼
P. blandianum, Dove, Marion Co., Tennessee	.68	182 (1.24)	166 (1.13)	2.68	4¼
P. vitreum, type, New Braunfels, Texas	.80	177 (1.38)	157 (1.26)	3.27	4¼
Sumidero, Mexico (high var.)	.91	141 (1.28)	132 (1.20)	3.7	4¼
P. conspectum conspectum (12336) Oakland, Cal. (big umb. for subsp.)	1.23	163 (2.00)	145 (1.78)	3.7	4¼
P. conspectum alleni (type), Pilsbry's measurements	1.7	135 (2.3)	.....	..	..
P. conspectum pasadenae (type), Pilsbry's measurements*	1.15	174 (2.00)	.....	3.7	4

Dimensions

		Shell		Umb. in maj. diam.	Whorls
P. conspectum jaliscoense (type), Pilsbry's measurements*	1.5	150 (2.25)	.....	3.1	4½

Key to North American Species of Punctum (also P. pygmaeum)

A. Shell with major riblets low and closely spaced; usually with less than 5 minor growth-threads in each interspace of last whorl (but, the larger the shell, the wider the interspaces.....Sect. *Punctum* s.s.

B. Whorls more rapidly increasing in diameter, which results in a smaller umbilicus in shells of the same maj. diam. index.

C. Shell higher; umbilicus more than 4 (usually about 5) times in maj. diam.

D. Shell larger; Fresno, Cal.—*P. californicum* Pilsbry

DD. Shell smaller; Seattle, Wash...*P. randolphii* (Dall)

CC. Shell more depressed; umbilicus less than 4 times in maj. diam.; last whorl not markedly descending; Lyons, France.....*P. pygmaeum* (Draparnaud)

BB. Whorls less rapidly increasing in diameter, which results in a larger umbilicus in shells of same maj. diam. index; shell almost always smaller than *P. pygmaeum* (see discussion).

E. Shell less depressed (than *P. pygmaeum*), with descending last whorl; umbilicus well-like; Cincinnati, Ohio .....*P. minutissimum* (Lea)

EE. Shell more depressed (than *P. pygmaeum*), last whorl not descending; umbilicus more open; Cades Cove, Great Smokies, Tenn. .....*P. blandianum* Pilsbry

AA. Shell with major riblets widely spaced and more prominent; usually with more than 5 minor growth-threads in each interspace of last whorl .....Sect. *Toltecia* Pilsbry

F. Shell minute and transparent; New Braunfels, Texas.
P. vitreum, new species

*In my statistics, the diameter of the umbilicus is its maj. diam. Dr. Pilsbry measures it along the axis of the maj. diam. of the shell, which gives a smaller dimension. My proportion for *jaliscoense* is taken from his figure.

FF. Shell large; epidermis usually pigmented.
P. conspectum (Bland)

G. Shell with higher spire, usually larger; Oswego, Oregon .....*P. conspectum alleni* Pils.

GG. Shell more depressed, usually smaller.

H. Shell brownish olive, usually higher, more shouldered whorls and more well-like umbilicus (almost 4 times in maj. diam.); San Francisco, Cal.....*P. conspectum conspectum* (Bld.)

HH. Color chestnut to cinnamon, usually with more depressed, rounded whorls and more open umbilicus.

I. Major riblets poorly developed; shell usually smaller; Pasadena, Cal.
P. conspectum pasadenae Pils.

II. Major riblets well developed; shell usually larger; Jalisco, Mexico.
P. conspectum jaliscoense (Pils.)

As will be noted from the foregoing table and key, I consider that *P. pygmaeum* has more in common with *P. randolphii* and *P. californicum* than with *P. minutissimum*. Besides its more gradual whorl-increase, this last species is almost always much smaller and higher and has a more markedly descending last whorl than *P. pygmaeum*. Thus, the Pennsylvania specimen, for which dimensions are given, is the biggest and lowest individual of a large series (ANSP. 46182); but, in the limestone and dolomite valleys of eastern Tennessee and northern Alabama, *P. minutissimum* is replaced by *blandianum*, a much more depressed form with a more open umbilicus. Although some lots (*e. g.*, ANSP. 144759, from Natural Bridge, Va.) appear to contain individuals more or less intermediate in form between *minutissimum* and *blandianum*, the latter is invariably much smaller than *P. pygmaeum*. On the other hand, occasional high-spired individuals of *minutissimum* from Alabama do attain a size equal to that of *P. pygmaeum*. The largest individual seen was in a lot (ANSP. 116824) of three shells labeled *P. blandianum*, which were collected by H. H. Smith from the Cumberland Plateau near Stevenson, Alabama; one of the others (small

and not quite mature) approaches *blandianum,* while the third is a young individual of *P. vitreum.* I have examined specimens of *P. minutissimum* (mainly ANSP. material) from Newfoundland, Prince Edward and Magdalen Islands, Canada, and from Maine, Massachusetts, New York, Pennsylvania, New Jersey, Delaware, Maryland, Virginia, North Carolina (Mitchell Co., Blue Ridge), Tennessee (Blue Ridge), Florida, Alabama, Michigan, northeastern Ohio (Sterki!), Illinois, Iowa, South Dakota, and Necaxa, Mexico. Two shells from the Sacramento Mts., New Mexico, are very close to *P. minutissimum,* although larger than usual. But, ANSP. lots from Arizona, Colorado, and Montana seem closer to either *P. californicum* or *P. conspectum.*

Punctum (Toltecia) vitreum, new species

Plate 7, figs. 3 to 6

Punctum pygmaeum, var. Pils. (1908, Proc. Acad. Nat. Sci. Philadelphia 58: 158), Texas: San Marcos, Hays Co. (ANSP. 90738); Comal Co. (ANSP. 90737, 90739); Hondo River, Medina Co.; Devil's River, Val Verde Co. (90740).

Type locality: pleasure gardens, New Braunfels, Comal Co., Texas (ANSP. 150609); collected during last week in June, 1929. D, I, a, 6; Sumidero, Mexico, 3400 ft.; one abnormally high shell. Additional localities from TEXAS: (ANSP. 134261) Nueces River; (ANSP. 140380) south bank of Colorado River, 1½ miles below Travis-Bastrop Co. line; valley of Guadalupe River, 2–4 miles north of New Braunfels, Comal Co. LOUISIANA: (ANSP. 106193) on opposite side of Red River, 13 miles above Alexandria, Rapids Parish (weak sculpture). ALABAMA: (ANSP. 112702) Tennessee River, near mouth of Widow's Creek, Jackson Co.; (ANSP. 116824) Cumberland Plateau near Stevenson, Jackson Co. TENNESSEE: Jasper and Dove, Marion Co.; Cherokee Bluffs, Knoxville, Knox Co.; Marbleton and Limestone Cove, Unicoi Co. VIRGINIA: (ANSP. 112436) Great Falls. MARYLAND: (ANSP. 109454) Bald Friar, Cecil Co.; (ANSP. 145817) Gunpowder

Falls, 16 miles northeast of Baltimore. NEW JERSEY: (ANSP. 109483) Big Springs, Springdale, Sussex Co.; (ANSP. 113444) near Garden Lake Station, west of Clementon, also (ANSP. 119416) Laurel Springs, Camden Co.; (ANSP. 141349) one mile south of Foul Rift, Warren Co. PENNSYLVANIA: (ANSP. 44909) Perkiomenville and (ANSP. 106014) Paper Mills, Montgomery Co.; (ANSP. 138798) near Tinicum Creek, Sundale, Bucks Co.; (ANSP. 139107) near Foul Rift, Northampton Co. IOWA: (ANSP. 62644) Iowa City. INDIANA: (ANSP. 81180) Lawrenceburg, Dearborn Co. (one juvenile shell).

P. vitreum is the only species of the genus which I have seen from Texas; I found it infrequent on fallen leaves under the mesophytic brush and trees along the limestone bluffs around New Braunfels. In Tennessee, *P. vitreum* occurs with *P. blandianum*; the former approaches the latter in frequency in the richer places near limestone or dolomite ledges, but *P. blandianum* is often the only *Punctum* in the more acid humus of the ridges. Around Philadelphia, *P. vitreum* is usually very much rarer than *P. minutissimum,* but, on the greensand marls around Laurel Springs and Garden Lake Station, New Jersey (ANSP. 119416, 113444), *P. vitreum* appears to be frequent and *P. minutissimum* very rare. A large part of the material in this region has been sorted out by Mr. E. G. Vanatta from humus collected by the botanist, Mr. Bayard Long.

Shell (figs. 3 to 5): minute, depressed turbinate; light corneous to vitreous and almost transparent. Whorls: $4\frac{1}{4}$ (maximum); later ones rounded but depressed (*i.e.,* elliptical in outline); last whorl slightly descending; suture strongly impressed (although more broadly so than in *P. minutissimum*). Embryonic whorls: $1\frac{3}{4}$, quite high; first whorl irregularly wrinkled but almost smooth; last $\frac{3}{4}$ whorl with fine spiral striae becoming more and more distinct. Later whorls: major growth-riblets high and thin, weakly arcuate just above periphery; interspaces with 5–10, very low but sharp, minor

growth ridges, which are crossed by fine, spiral lines so that minute squares (fig. 6) are formed. Umbilicus: open, about 3.3 times in maj. diam. of shell. Aperture: depressed; alt. 55 (.44 mm.), diam. 118 (.52); slightly oblique (about 25° to axis of shell). Peristome: simple and sharp; weakly arcuate above periphery. Pallial complex: as in *P. conspectum jaliscoense.*

This species is about the size of *minutissimum* but has more depressed whorls and the sculpture of the *Toltecia* group (*i.e.,* the contrast between the major and minor growth-riblets is much greater and the former are more widely spaced). *P. vitreum* also has thinner and more lightly colored epidermis, and its sculpture is more delicately and sharply cut. Under the binocular, *P. minutissimum* looks as if it were moulded out of bronze, but *P. vitreum* appears as if it were cut from yellowish crystal.

Considerable variation in form is represented in the various lots of *P. vitreum* which have been examined. Typical *vitreum* from Texas is larger and more depressed than the shells from New Jersey. The single Sumidero individual has much the highest spire of all, but is almost as large as the maximum size of the Texan specimens.

Punctum (*Toltecia*) *conspectum jaliscoense* (Pilsbry)

P. jaliscoense H. B. B. (1927: 227, pl. 16, f. 8–12), anatomy of Chapultepec animals.

Type locality: Guadalajara, Jalisco. F, II, ab, 14; Chapultepec, 7450 ft.; frequent on damp rocks.

These Chapultepec specimens average smaller and more depressed than do the type lot.

Rotadiscus hermanni hermanni (Pfeiffer)

R. hermanni H. B. B. (1927: 228, pl. 16, f. 13–20), anatomy of Necaxa animals.

Type locality: Mirador, V. C. BC, III, c, 21, 33–35, 37, 41; Necaxa, 4500–5500 ft.; from bare patches of bark on moss-grown trees in the fog zone; quite infrequent.

The Necaxa individuals are slightly smaller than the dimensions given by Strebel and Pfeffer. This species has a radial, internal barrier similar to, but less protractive and relatively heavier than those in *Paravitrea lamellidens* (Pils.). On account of the opacity of even fresh specimens, a determination of the number present is difficult; one (in the last half whorl) is the most I can find in any specimen, although it does occur in shells of different sizes. This barrier is about half as long as the combined basal and palatal whorl-margin and extends from the middle of the former to near the "shoulder" of the latter. Internal armature is usually absent in North American Endodontidae and this type has not previously been noted, even in the Pacific species.

Rotadiscus hermanni nivatus, new subspecies

Type locality: C, I, c, 11; between La Venta and El Desierto de los Léones, 9700–9850 ft.; similar habitats to those of typical subspecies; rare.

Shell: similar to that of typical *hermanni*; internal barrier present; umbilicus 2.5 times in major diameter. Growth-riblets: more widely spaced; on last whorl, about 3 interspaces in *nivatus* equal 5 in typical *hermanni*.

	Shell			Aperture		Whorls
Largest shell ..	1.05	197(2.07)	182(1.91)	72(.76)	91(.69)	5

Radiodiscus millecostatus costaricensis Pilsbry

R. millecostatus costaricensis H. B. B. (1927: 230, pl. 17, f. 21–24), anatomy of Necaxa examples.

Type locality: Banana River, Costa Rica. BC, III, c, 11, 21, 33, 35, 37; Necaxa and El Desierto, 4500–9850 ft.; same places as *Rotadiscus*; frequent.

The Necaxa specimens agree very well with the Costa Rican cotypes, but those from El Desierto are somewhat larger. The shells from all three localities have straighter growth-riblets

than typical *millecostatus*, in which the sculpture and the peristome are arcuate above the periphery of the shell and emarginate at the suture.

Radiodiscus proameri, new species*

Plate 7, figs. 7 to 9

Type locality: station 35, Necaxa. ABC, I, c, 6, 35, 41; Sumidero and Necaxa; 3400–4925 ft.; with *R. millecostatus costaricensis* at Necaxa, but much rarer.

Shell (figs. 7–9): minute, depressed; light brown and translucent. Whorls: 4½, high and rounded; last whorl slightly descending. Embryonic whorls: 1½, ornamented with impressed spiral lines, which separate very closely spaced ridgelets (21 visible one whorl from apex); growth-lines emerging in last half whorl. Later whorls: major growth-riblets low but angular, closely spaced (115 on last whorl, where they are about as broad and high as the width of their interspaces), very slightly arcuate above periphery; minor growth-threads very fine, on sides of and between major ones (3–6 from crest to crest on last whorl); spiral lines prominent, surmounting incremental sculpture, quite closely spaced (about ⅜ as distant as major riblets). Umbilicus: open (2.9 times in maj. diam.). Aperture: kidney-shaped, almost vertical. Peristome: simple and sharp, weakly emarginate just below suture.

	Shell			Aperture		Whorls
Type shell	.79	172(1.36)	162(1.28)	66(.52)	96(.50)	4¼

R. proameri is much smaller and has more closely spaced riblets and more compressed whorls than *R. millecostatus*. Its sculpture is remarkably fine and regular.

Chanomphalus pilsbryi (H. Burrington Baker)

Planogyra pilsbryi H. B. B. (1927: 233, pl. 20, f. 51, 52), anatomical notes on Necaxa specimens.

* Named for Mr. Oscar Proamer, the superintendent at Necaxa.

Type locality: Hacienda Cuatotolapam, V. C. D, III, a, 6, 53; Sumidero and Necaxa, 3400 and 3000 ft.; terrestrial and apparently rare.

Helicodiscus eigenmanni (Pilsbry), new subspecies?

Type locality (of species): Beaver Cave, Hays Co., Texas. C, I, a, 36; near Necaxa, 4600 ft.; one dead shell.

Shell: relatively higher and heavier, but smaller than typical *eigenmanni.* Whorls: 5½; last half whorl descending. Embryonic whorls: 1½, with distant spiral ridgelets. Later whorls: growth-wrinkles considerably stronger and spiral ridgelets weaker than in typical subspecies. Umbilicus: much deeper, well-like; 2.5 times in maj. diam. of shell. Aperture: slightly oblique (direction of growth-lines about 20° from axis of shell).

	Shell			Aperture		Whorls
Dimensions	2.12	186(3.94)	171(3.64)	63(1.33)	71(.94)	5¼ (broken)

This shell is perhaps specifically distinct from *H. eigenmanni,* as the latter does not appear to approach it in shape. However, until better material is obtained, it is best left as an unnamed subspecies. It extends the North American range of *Helicodiscus* s.s. considerably to the southward.

Gonyodiscus (*Mexicodiscus*) *victorianus* (Pilsbry)

Type locality: Victoria, Tamaulipas. D, II, a, 53; Necaxa, 3000 ft.; one dead shell.

This specimen has higher, narrower whorls and a smaller umbilicus than the type. This record also extends the range of a northern genus to the southward.

FERUSSACIIDAE

Cecilioides (*Karolus*) *consobrinus primus* (De Folin)

Type locality: Vera Cruz. D, II, a, 53; Necaxa, 3000 ft.; one dead shell.

Philomycidae

Pallifera costaricensis alticola, new subspecies

Plate 8, figs. 2 to 4 and 6

Type locality: in a rotten Douglas fir log near El Desierto de los Leónes (9850 ft.). C, III, a, 12, 14; also from oak log near walls of monastery at Desierto (much lighter in color, bands indistinct) and from oak brush near Santa Rosa (8525 ft.; juvenile, unicolor light gray except for slight chestnut tinge along pedal grooves).

Living animal: about 70 mm. in length; dorsum light golden yellow with very heavy, jet-black, mid-dorsal stripe and two slightly narrower lateral ones, each located a little less than half way to mantle edge; edge of sole and tentacles dark gray. Preserved specimen: yellow faded; contracted to 45 mm. in length. Foot: quite slender, extending beyond mantle as a narrowly rounded posterior projection; pedal grooves double, separating near head; sole undivided (lateral edges more wrinkled in contracted specimen; *cf.* Strebel and Pfeffer).

Lung (fig. 4): on right side and about $\frac{1}{3}$ length of dorsum; an ovoid sac, truncate at posterior end but bluntly pointed anteriad; entire lining (when cut along lower left attachment to body wall and reflected) almost as wide as long and twice length of kidney; external opening near lower edge and about length of kidney from lower posterior corner; principal pulmonary vein dividing immediately into numerous, complexly-branched trunks, one of which circles back along edge of pericardium and kidney. Pericardium: oblique to kidney and partially imbedded in ventral surface of latter; renopericardial orifice opposite middle of left anterior side of ventricle; aorta traversing groove in kidney (not piercing renal substance). Kidney: crescentic triangular, but partially divided into two lobes by pericardium; about $1\frac{1}{3}$ times as long as its base or $1\frac{1}{2}$ times length of pericardium; "primary" limb encircling anterior end of kidney and running back on opposite side to point on diaphragm near aortic exit; "secondary" limb swollen into a richly vascular chamber between kidney,

hindgut, and posterior edge of diaphragm; external ureteric opening at posterior end of a groove which runs along dorsal side of pneumostome and is marked off from both last and lung cavity by heavy ridges. Hindgut: entering diaphragm near lower posterior corner; anus in anterior side of pneumostomatic ring. Shell cavity: as large as dorsum; empty.

Ovotestis (fig. 6): jet-black; irregularly ovoid but lumpy; imbedded in ventral portion of liver some distance in front of posterior end. Hermaphroditic duct: slightly enlarged and briefly convoluted at posterior loop; talon a small ovoid enlargement of anterior loop; last limb (carrefour) imbedded in albumen gland. Albumen gland: bright orange in color and very large; curved around ventral and right sides of stomach near middle of haemocoele. Uterus: gray, about 5 times as long as albumen gland (or penis), but closely looped and convoluted; walls thick, mucilaginous and coarsely sacculate. Free oviduct: slender and very short. Spermatheca: long type; sac large, ovoid, imbedded on left side of haemocoele between anterior and middle limbs of intestinal S-loops; stalk slender but slightly enlarged near base, apparently situated as in many Endodontidae (*i.e.*, at least its base describes a dextral spiral around uterus on side opposite prostate). Vagina: relatively large, with spacious lumen; wall thickened by light cream-colored, closely packed, glandular alveoli. Prostate: long type, voluminous, cream-colored. Vas deferens: caught into penioviducal angle by right ommatophoral retractor; simple (neither epiphallus nor penial papilla distinctly differentiated). Penis: a large and quite simple, elongate sac, tapered at anterior end, which is surrounded by a heavy, muscular accessory sheath; also slightly narrowed near posterior end; entrance of vas deferens almost apical. Internal structure of penis (fig. 3): region around opening of vas deferens thin-walled, with radiating folds and a heavy, undulate, sphincteric plica, marked off from remainder of penis by sharp upper edge of principal penial pilaster; major portion of male organ thick-walled with a vague pilaster along ventral

wall, from which transverse folds radiate; dorsal side of region inside basal sheath with thinner wall, slightly sacculate; cloacal taper longitudinally plicate. Penial retractor: short and stout; origin just outside of that of left tentacular retractor; insertion on apex of penis. Cloaca: short and stout; wall with glandular alveoli (like vagina); external orifice just behind right inferior tentacle.

Pedal retractors: apparently represented by two fields of muscle, fused to foot, on bottom of haemocoele and demarcated from each other by a midventral groove; origins of buccal, tentacular, and penial retractors from lateral edges of these fields. Buccal retractors: arise as two slender slips of muscle which lie either side of haemocoelic floor opposite pedal grooves; these can be traced back almost to posterior end of cavity; near middle of body each receives other strips of muscle from same line and becomes completely free as a slender ribbon, which, under middle of salivary glands, gives and receives a small strip from its fellow; just before this, left band gives off a very fine slip to left tentacular retractor. Common tentacular retractors: each arises as successive slips which begin just in front of last head of buccal retractor and in line with it; each divides opposite posterior end of buccal mass into a large ommatophoral and a smaller inferior muscle; last divides into a retractor of inferior tentacle and a muscle to corresponding corner of lips; right ommatophoral muscle passes between penis and vagina. Buccal protractors: 4 or 5 small, branching slips on each side; origins along anterior margin of foot-plate.

Buccal mass: short, subglobular. Salivary glands: subequal in size, left one slightly more anteriad; each roughly lanceolate with lobulate margins; posterior ends adjacent although not confluent below oesophagus; ducts about twice as long as glands. Jaw (fig. 2): crescentic in shape; heavy; imbedded (formative) border whitish, remainder dark maroon in color; central region with 7, low and flat, radial ribs; cutting edge (in type) badly and unequally worn, so that rib-strengthened center is left as a prominent point. Radular formula: of the

type, about 18–28–1–46 with 183 rows; of a smaller specimen, 16–22–1–38 with 149 rows.

The genitalia of *Pallifera* Morse and the Oriental genus, *Meghimatium* van Hasselt, agree with each other and differ from those of *Philomycus* in the absence of dart and dart sac. Apparently all three genera have a more or less extensive zone of glandular alveoli on the female side, but they differ in its position. In *Pallifera,* at least in the Central American species, this glandular zone covers both the cloaca and the vagina; in *Philomycus,* according to Leidy, it is limited to the cloaca; while in *Meghimatium,* as shown by Simroth and by Hoffmann, it is developed around the spermathecal stalk. In conjunction with this, *Meghimatium* has a long free oviduct and a very short vagina while *Pallifera* reverses this relationship; also, the former genus has a swollen spermathecal stalk while that of *Pallifera* is slender. In addition, *Pallifera* does not develop any structure that corresponds to the "ligula" of *Meghimatium.*

P. costaricensis alticola attains a considerably large size than either typical *costaricensis* or *crosseana;* also, the prominence of the mid-dorsal black stripe is rather peculiar, although a lighter band may be present in *crosseana,* and the Santa Rosa juvenile of *alticola* is apparently an albino. In addition, the habits of *alticola* and *crosseana* appear to be different; the former lives in rotten wood while the latter is almost invariably seen on the trunks and limbs of trees, some distance above the ground. However, individuals of *Philomycus carolinianus* differ in the same way; in the northern part of the United States, this species is usually found in rotten wood; in eastern Tennessee it is a very ambitious climber.

Pallifera costaricensis crosseana (Strebel und Pfeffer)

Plate 8, figs. 1 and 5

1. *Philomycus costaricensis* Mörch (1858, Vidensk. Medd. Naturh. For. Kjöbenhavn 1857: 341; 1859, Mal. Bl. 6: 109), Costa Rica at 2000 ft. *Tebennophorus costaricensis* W. G. B. (1879, Ann. Acad. Sci. N. Y. 1: 261, pl. 11, f. M, N), jaw and radula from Costa Rica. *Ph. costa-*

ricensis var. *a* Ckll. (1913, Naut. 27: 3), jaw and radula from Panamá.

?*T. auratus* Tate (1870, Amer. Jour. Conch. 5: 153), Javali in Chontales, Nicaragua.

?*Ph. columbianus* n. sp? n. f? Simroth (1913, Mém. Soc. neuchâtel. Sci. nat. 5: 272), near Angelopolis, Colombia (1820 meters in central Cordillera).

2? *Tebennophorus sallei* Crosse et Fischer (1869, Jour. de Conch. 17: 190; 1872, Miss. Mex. Moll. I: 191, pl. 9, f. 6–12), Playa Vicente, V. C.

3. *T. crosseanus* S. und P. (1880,* Beitr. IV: 25, pl. 10, f. 6, pl. 9, f. 13, 22), no locality (probably eastern Mexico).

Type locality: unknown. ABCD, III, c, 4, 6, 21, 23, 33, 41; Córdoba, 2625–3400 ft.; Necaxa, 4265–5200 ft.; on trunks and limbs of trees.

Mörch's original description of *costaricensis* is very brief, but does indicate that Oersted's figure of the living animal was about 45 mm. long and showed a mid-dorsal line and sparse spots of black on a yellowish background. W. G. Binney describes the jaw and radula of other Costa Rican specimens (living animal 30 mm. long; dorsum with three rows of spots). Cockerell gives 11.5 mm. as the length of his largest animal (in alcohol) and describes the color a pale ochraceous with a pair of subdorsal rows of crowded gray spots. Tate's and Simroth's descriptions only give external features (lengths contracted: 12.7 and 19 mm., respectively). None of these accounts give any characters by which the three names (*costaricensis, auratus,* and *columbianus*) can be separated from the East Mexican specimens.

The status of *T. sallei* is very dubious. Its external features (preserved animal unicolor, ash-gray and 25 mm. long) agree very well with what is termed here *crosseana.* Its authors claim that the jaw lacks ribs and that the genitalia have a dart sac (as in *Philomycus*); but, their figure of the jaw shows rather definite radial striae, and their description of the genitalia is included under the discussion of the genus, without definite assignment to *sallei.* Until a true *Philomycus* is found in Mexico, *T. sallei* should be regarded as a *nomen dubium.*

* According to von Martens (1880, Zool. Rec. 16: Moll. 10) this was "really published in November, 1879."

The name *crosseana,* as a subspecies, is accepted here because my own material comes from the same general region as most of Strebel's mollusks. Pfeffer and he also indicate that their species has a ribless jaw, but the broad (imbedded) zone in their figure presents convincing proof that they viewed the structure from its ventral side and also does show indications of the central ribs. In radula and external features (contracted animal 16 mm.; brownish dorsum almost covered with dark gray spots and with a blackish lateral ring), it falls within the range of variation in my material.

This subspecies is very variable, both in coloration and in size. Animals from a very limited area usually resemble each other, but another lot from a nearby locality may be quite different. As a rule, the animals from the lower altitudes are smaller; my littlest sexually mature specimen (12 mm. long, contracted) comes from Córdoba (2626 ft.) while my largest (30 mm. long, contracted) comes from station 21 at Necaxa (about 4700 ft.). The more darkly pigmented individuals are from the fog zones. Those from Sumidero have two black, lateral bands and a fine median brownish one on a brown background. A juvenile from station 21 at Necaxa has only a narrow mid-dorsal stripe. The large specimens from stations 23, 33, and 41 at Necaxa are brownish and have only the two lateral bands. The small animals from Córdoba are light and either unicolor or with scattered darker blotches.

The anatomy in these lots of *crosseana* presents no very significant differences from that in *alticola.* Of course, all of the organs are much smaller. The ovotestis is more lightly pigmented. The penis is more slender and elongate in the specimens dissected, but this difference may be largely due to the amount of contraction. The jaw (fig. 5) is dark corneous in color and appears to have stronger and more regular ribs. As in *alticola,* its growth striae are fine, sharp, and sometimes accompanied by zones of darker color; in the older specimens, the surface of its retractor may also be chitinized so as to approach the "elasmognath" condition in *Succinea.* The radula seems to show a relatively smaller proportion of bicuspid teeth

than in *alticola*. Formulae are: for a small specimen (station 4; fig. 1), (16–18)–(15–13)–1–31, with 141 rows; and for a large animal (station 33) about 20–21–1–42, with 172 rows. The marginals (multicuspid teeth) are rather variable in number and exceedingly variable in form. From 2 to 5 ectoconal points may be developed; although the number is very unstable, even in a single longitudinal row, it tends to increase out to the last 3 or 4 teeth. Some of these smaller cusps seem to result from a subdivision of the mesocone (*cf.* teeth 20 and 22 in fig.), others from ectoconal splitting, and even an occasional interstitial cusp may be present (tooth 22). In one specimen, the mesocone shows considerable tendency to increase in width at the expense of the ectoconals; even practically unicuspid marginals occur.

Zonitidae

Guppya gundlachi orosciana von Martens

G. gundlachi orosciana H. B. B. (1928, Proc. Acad. Nat. Sci. Philadelphia 80: 8, pl. 1, f. 5), anatomy of Córdoba specimens.

Type locality: Calera de San Ramón, Costa Rica. AD, I, a, 4, 6; Córdoba and Sumidero, 2625–3400 ft.

Guppya biolleyi von Martens

G. biolleyi H. B. B. (1928: 7, pl. 1, f. 1–4), anatomy of Necaxa animals.

Type locality: Costa Cuca, western Guatemala. ABCD, III, ad, 21, 23, 33–35, 37, 38, 52–54; Necaxa, 2625–5500 ft.; frequent on lower vegetation.

Guppya sterkii punctum, new subspecies

Plate 7, figs. 14 to 16

Type locality: near Necaxa, 2625 ft. (station 54). CD, III, a, 33, 54; Necaxa, 2625–5000 ft.; one specimen from each station.

Shell (figs. 14–16): minute, subdepressed; light corneous and transparent; similar to *G. sterkii* (Dall). Whorls: 3¾,

relatively high and globose, slightly overlapping each other; suture obliquely beveled. Sculpture: as in *G. sterkii* (*i.e.*, with weak growth-lines and the numerous, sharp spirals of the genus). Umbilicus: perforate (22 times in maj. diam. of shell). Aperture: crescentic slightly oblique (about 25° to axis of shell). Peristome: sharp, slightly arcuate in basal region; weakly reflexed in columellar.

	Shell			Aperture		Whorls
Type	.75	163(1.22)	147(1.10)	69(.52)	112(.58)	3¾

This subspecies (or species?) is slightly smaller than *sterkii* and has relatively higher whorls and less distinct suture. Also, the umbilicus of *punctum* is actually perforate and not simply indented, and its sutural spiral, in apical view, is relatively narrower, although slightly more raised. The type is evidently an adult shell as the growth-lines near its peristome are heavier and more closely spaced.

Habroconus (*Ernstia*) *elegantulus* (Pilsbry)

H. elegantulus H. B. B. (1928: 12, pl. 1, f. 9), anatomy of Necaxa animals.

Type locality: Valles, San Luis Potosí. ABCD, III, acd, 1, 3–6, 23, 24, 33–38, 51–55. Atoyac to Sumidero, 1300–3400 ft.; Necaxa, 2215–5500 ft.; the most abundant species on low vegetation at all altitudes.

The specimens from lower altitudes appear to average slightly larger than those from higher ones.

Habroconus trochulinus (Morelet)

Plate 7, figs. 10 and 11

Helix trochulina Mo. (1851, Test. Nov. II: 10), in part ("vel corneofulva"). *H. selenkai* Pfr. (1866, Mal. Bl. 13: 77), in part ("cornea"). *Habroconus selenkai* S. und P. (1880: 23, pl. 4, at least right hand fig. 1a), in part. *Guppya trochulina* H. B. B. (1922, Occ. Pap., Mus. Zool., Univ. Mich. no. 106: 47, pl. 17, f. 4, 5), radula and jaw. *H. trochulinus trochulinus* H. B. B. (1928: 13), anatomy of Necaxa examples.

Type locality: Mts. Peten, Guatemala. ABCD, III, de, 3–6, 35, 41, 51–55; Peñuela to Sumidero, 2625–3400 ft.; Necaxa, 2215–4925 ft.; common at lower altitudes on leaves of shrubs and trees, quite arboreal; rare above Necaxa Falls.

As suggested in the foregoing synonymy, the original description of either *trochulinus* or *selenkai* appears to include both of what are here regarded as separate species. Additional evidence in regard to Pfeiffer's *selenkai* is contained in two lots in the Academy of Natural Sciences of Philadelphia (ANSP. 48730 and 48731); both of these are from the Swift Collection and give Mirador as the locality; the label of one also cites Berendt as the collector. One lot (48730) of these probable paratypes of *selenkai* is what I am segregating as *H. trochulinus* while the other is *H. selenkai.*

H. trochulinus (figs. 10, 11) is a heavier and higher shell than *H. selenkai* and has more markedly angulate and more closely wound whorls; its color varies from rich fulvous to corneous and the apical side of each whorl develops the fine, closely spaced growth-riblets like those in *Euconulus, Pseudoguppya,* and *Ernstia. H. selenkai* (pl. 7, figs. 12, 13) is more globose and not so markedly angulate; its very thin shell is greenish-white and its much weaker growth-sculpture renders its spirals more evident, at least on the apical sides of the whorls. Also, *H. selenkai* is much more completely arboreal, although *H. trochulinus* commonly climbs up into the lower strata of the vegetation. Possibly, the two represent ecological forms, in which differences in form and texture may be correlated with diversity of habitat, but they do not appear to intergrade, even when they occur together. Although both species often live in the same locality, my largest series of *Habroconus* comes from station 53 and contains only *H. elegantulus* and *H. trochulinus.*

	Shell			Aperture		Whorls
H. trochulinus						
(st. 53) ...	4.27	116(4.93)	109(4.66)	46(1.95)	132(2.57)	6¾
H. selenkai						
(st. 54) ...	3.92	125(4.91)	118(4.61)	52(2.02)	123(2.49)	6+

Habroconus selenkai (Pfeiffer)

Plate 7, figs. 12 and 13

Helix trochulina Mo. (l. c.), in part ("corneo-albicans). *H. selenkai* Pfr. (l. c.), in part ("vel hyalina"). *Zonites selenkai* F. et C. (1872, I: 171, pl. 7, f. 9), in part (fig. cited). *H. selenkai* S. und P. (1880: 23, pl. 4, f. 1), in part. *H. trochulinus*, form *selenkai* H. B. B. (1928: 13, pl. 2, f. 4, 5), anatomy of Necaxa animals.

Type locality: Mirador, V. C. D, III, de, 1, 54, 55; Atoyac, 1300–1475 ft.; below Necaxa Falls, 2215–2625 ft.; more arboreal than preceding and apparently less abundant.

Animals of this species turn green the alcohol in which they are preserved; this seems to be evidence that they actually feed on leaves.

Retinella (*Perpolita*) *subhyalina subhyalina* (Pfeiffer)

R. subhyalina subhyalina H. B. B. (1930, Proc. Acad. Nat. Sci. Philadelphia 82: 199, pl. 9, f. 13), anatomy of animals from Necaxa.

Type locality: Mirador or near Vera Cruz, V. C. BC, III, ab, 23, 34, 35, 38, 41; Necaxa, 4265–5000 ft.; on ground under leaves or on wet cliffs.

Retinella (*Glyphyalinia*) *indentata paucilirata* (Morelet)

R. indentata paucilirata H. B. B. (1930: 211), anatomy of animals from San Juan Teotihuacán.

Type locality: near Salama, Guatemala. BCE, III, a, 13, 33, 35, 38; San Juan Teotihuacán, 7510 ft.; Necaxa, 4430–5000 ft.

All these Mexican specimens are smaller than typical *paucilirata* or examples from New Braunfels, Texas.

Genus *Mesomphix* Rafinesque

Mesomphix Raf. (1818, Am. Monthly Mag. 4: 107), nude; Raf. (1819, Jour. Phys. Paris 88: 425), defined without species; Férussac (1821, Tabl. Syst. Limaçons: 41), with two nude species, *Helix planorboides* "Raf." and *Helix laevigata* "Raf.," which were later defined by Fér. (1822, Hist., pl. 82, f. 4 and 6), from Kentucky; type by subsequent designation of Herrm. (1847, Ind. Mal. II: 7) *Helix laevigata* Raf.

Omphalina Raf. (1831, Enum. and Account: 3), monotype *O. cuprea* Raf. (l. c.) from Kentucky; used here as subgenus (although probably a mere emendation of *Mesomphix*).

Mesomphyx Gray (1842, Syn. British Mus.: 90); Agassiz (1846, Nomen. Zool., Moll. p. 54; Ind. Univ., p. 231), misspellings; Gray (1847, Proc. Zool. Soc. London: 172), tsd. *Helix concava* Say.

Moreletia Gray (1855, Cat. Pulm. Brit. Mus.: 148), monotype *Zonites euryomphala* = *Helix euryomphala* Pfr. (1845, Proc. Zool. Soc. 13: 71), Vera Paz, Guatemala; used here as section of *Omphalina*.

Zonyalina von Mart. (1865, Mal. Bl. 12: 16), monotype *Hyalina bilineata* = *Helix bilineata* Pfr. (1845: 128); used here as section of *Omphalina*.

Patulopsis Strebel und Pfeffer (1880: 16), monotype *P. carinatus* S. und P. (l. c.); used here as subgenus.

Omphix Pils. (1911, Proc. Acad. Nat. Sci. Philadelphia 62: 479), type by original designation *M. inornata* = *Helix inornata* Say (1821, Jour. Acad. Nat. Sci. Philadelphia 2: 371), Pennsylvania; used here as subgenus.

Micromphix Pils. (1911: 479), tod. *Mesomphix subplana* = *Helix subplana* Binn. (1842, Jour. Boston Soc. Nat. Hist. 4, pt. 1, cover, p. 3) from Tennessee; used here as section of *Omphix*.

Omphalinella, new subgenus, type *Helix veracruzensis* Pfr. (1856, Proc. Zool. Soc. London: 318) from Córdoba, V. C.

Although no sane person would describe *M. laevigatus* as a species with "un grand ombilic," the acceptance of any of Rafinesque's conchological chaos always presupposes certain allowances. Férussac (1821), who first included species in *Mesomphix*, used the name as if masculine, and "omphix" is probably a corruption of "omphalos." On the advice of Dr. Pilsbry, I am now combining *Mesomphix* and *Omphalina* under the older name. The following key to the subdivisions of *Mesomphix* outlines their proposed arrangement.

A. Penial retractor inserted apically; central (tricuspid) and laterals of radula with relatively short backs; shell with embryonic whorls almost smooth (with weak, spiral striae) except in *Patulopsis* s. s. (*Omphalina* Pils., 1911)

B. Penis not divided into two compartments; basal swelling of spermathecal stalk much smaller than terminal sac; shell usually large.....Subgenus *Omphalina* Raf.

C. Shell solid with heavy sculpture; whorls more gradually increasing; laterals of radula said to be tricuspid; Guatemala .....Section *Moreletia* Gray

CC. Shell usually thinner with weaker sculpture; whorls more rapidly increasing; laterals bicuspid

D. Penial papilla not prominently developed (as far as known); vagina with well developed, brown, glandular collar; shell duller, usually almost unicolor (or with narrow, dark stripe near periphery); eastern U. S. to Guatemala..... .....Section *Omphalina* s. s.

DD. Penial papilla large but low; vaginal collar reduced and almost colorless; shell polished, usually with dark zones and light stripes; Mexico..... .....Section *Zonyalina* Mart.

BB. Penis divided into an apical and a basal compartment by prominent fold; vas deferens relatively slender; spermathecal stalk basally with thick-walled, ovoid swelling which is about as big as terminal sac; vaginal collar vestigial; shell small; Mexico..... .....Subgenus *Patulopsis* S. und P.

E. Penial lumen divided by a V-shaped fold; shell with weak sculpture except near suture .... Section **Omphalinella,** new

EE. Penial lumen divided by a high, glandular ring near apex and a lower, almost complete, transverse fold; apical side of shell with sharp ribs which begin ½ whorl from apex .....Section *Patulopsis* s. s.

AA. Penial retractor inserted below apex (penial flagellum differentiated); vagina without conspicuous glandular collar; centrals and laterals (when developed) with elongate backs (*Mesomphix* Pils., 1911); eastern United States

F. Penial flagellum long; radula with tricuspid central and bicuspid laterals.....Subgenus *Omphix* Pils.

G. Shell with embryonic whorls almost smooth..... .....Section *Micromphix* Pils.

GG. Shell with embryonic whorls radially striate..... .....Section *Omphix* s. s.

FF. Penial flagellum short; radula with unicuspid laterals and central (vestigial); shell with embryonic whorls radially striate.....Subgenus *Mesomphix* s. s.

M. (*Omphalina*) *lucubratus caducus* (Pfeiffer)

Plate 9, fig. 1

O. lucubrata Pils. (1911: 470, pl. 37, f. 8), genitalia from Texolo, V. C.

Type locality: Córdoba, V. C. AD, I, a, 3–6; Peñuela to Sumidero, 2625 to 3400 ft.; frequent among dead leaves on ground.

The series of shells from around Córdoba is very variable in all of the characters used by von Martens for the separation of *lucubratus* and *caducus*. In fact, my only reason for the retention of *caducus*, even as a subspecies, is the fact that *lucubratus* was founded on an immature shell (ANSP. 48721) which probably came from much farther north in Mexico (Panuco River valley?). Most of my specimens develop a narrow chestnut border below the suture after about the second whorl. Although the individual from the highest altitude (st. 6) is the largest and specimens from the lowest locality (st. 3) are small, a bigger series will be necessary for an accurate correlation of size and altitude.

	Shell			Whorls
Peñuelo (st. 3)				
2 adults	13.2	162 (21.4)	136 (17.8)	5¼
	15.1	145 (21.8)	124 (18.7)	5½
Córdoba (st. 4, 5)				
means, 18 adults...	14.4	163 (23.4)	137 (19.7)	5.47
minima	13.2	152 (21.8)	129 (18.3)	5¼
maximá	15.8	172 (25.0)	143 (21.1)	5¾
Sumidero (st. 6)				
1 adult	14.6	173 (25.2)	138 (21.0)	5½

Most of the animals are slightly immature sexually but the following notes are founded on a mature individual from station 4.

Talon: much as in *bilineatus*. Uterus: brown, elongate, and complexly sacculate. Free oviduct (fig. 1): swollen apically with whitish glandular zone; slender below. Spermatheca: short type; sac large, imbedded near base of uterus, filled with flocculent material; stalk slender. Vagina: short; glandular collar narrow and mainly imbedded in body wall but distinctly brownish. Prostate: rather narrow and partially over-

lapped by uterus. Vas deferens: rather slender, attached along penis by fiber complex (omitted from fig.), without definite penial papilla. Penis: long and quite slender; internal wall with 6 pleated longitudinal folds, which become broader but lower and simpler near base. Cloaca: very short; external opening much as in *Retinella*. Right tentacular retractor: free from genitalia.

The genitalia of this specimen seem quite similar to (penis less retracted than) those figured by Dr. Pilsbry from Texolo (near Jalapa) and, from these accounts, the anatomy of *M. lucubratus caducus* appears closest to that in *M. kopnodes* (W. G. B.). If Pfeffer's studies are accurate, *M. angiomphala* (S. und P.) from more northern Vera Cruz is a distinct species, with a penis more like that in *M. cupreus* (Raf.); its shell seems very close to that of *M. zonites* (Pfr.) from Chiapas, which has priority. The section *Omphalina* s. s. may also include *M. paradensis* (Pfr.) from Oaxaca and *M. martensianus* (Pils.) from Guatemala; both of these appear to develop more strongly impressed, radial lines (like *Glyphyalus* in *Retinella*). The section *Moreletia* remains monotypic.

M. (*Omphalina*) *lucubratus strebelianus* (von Martens)

O. caduca strebeliana Mart. (1892, Biol.: 108) founded on *Moreletia fuliginosa*, form *B* of S. und P. (1880: 6, pl. 8, f. 7).

Type locality: near Misantla, V. C. A, I, a, 32, 33; summits above Necaxa, 5000 to 5400 ft.; very rare.

All of the large specimens are dead shells in poor condition.

M. (*Zonyalina*) *bilineatus* (Pfeiffer)

Plate 9, figs. 2 to 4

Z. bilineata S. und P. (1880: 12, pl. 8, f. 4, pl. 9, f. 5, 6, 18), anatomy.

Type locality: Córdoba, V. C. AD, I, a, 4–6; Córdoba to Sumidero, 2625 to 3400 ft.; quite common among dead leaves on ground.

Juvenile specimens of this species are unicolor like the color-form *apicalis* (Mart.). The dark bands begin as narrow lines

at varying stages of growth but apparently in constant sequence; the sutural one begins first but is shortly followed by the peripheral, which makes the typical pattern. The basal stripe is much the last to appear and produces *venustus* (S. und P.), or, if the two other stripes coalesce, results in *bizonatus* (Mart.). Most of the shells from Sumidero have broad bands in the *venustus* pattern but one, with the three dark zones almost invisible, must approach *apicalis*. The Córdoba specimens usually show narrower sutural stripes and one (out of 9 adults) lacks the basal band (typical form). The *bizonatus* pattern is represented by a single immature individual from Córdoba. Although the ground color varies considerably, the umbilical whitish (opaque) area is usually quite distinct. The shells from the lower altitude (Córdoba) are wider but relatively more depressed and have developed a fraction of a whorl more.

	Shell			Whorls
Córdoba (st. 4, 5)				
means, 8 adults....	10.2	172(17.6)	147(15.0)	5.47
minima	9.4	163(16.1)	140(14.0)	5¼
maxima	10.9	184(18.3)	156(15.4)	5½
Sumidero (st. 6)				
means, 8 adults....	10.2	165(16.8)	144(14.7)	5.37
minima	9.5	155(15.7)	136(13.8)	5¼
maxima	10.9	177(18.2)	155(15.8)	5½

The section *Zonyalina* (in *Omphalina*) probably also includes *M. modestus* (Mart.) from Jalapa and *M. tuxtlensis* (C. et F.) from Tuxtla, V. C., although the latter has more globose whorls like *Omphalina* s. s. As Pfeffer's account appears to be somewhat inaccurate, the anatomy of *M. bilineatus* is described below in detail. My figures are founded on Sumidero individuals.

Animal: dorsum of head, tail, and mantle edge, outlines of all tessellations and especially pedal grooves darkly pigmented, often almost black; outer zones of sole grayish. Man-

tle edge: very thick; right lappet prominent, black and crescentic, left one quite large, heavy, cleaver-shaped, and darkly pigmented, left accessory small but distinct and dark; umbilical lobe scarcely represented. Lung: about twice as long as its base or length of kidney; principal vein with large tributaries on both sides. Kidney: 1½ times as long as its base, or length of pericardium.

Talon (fig. 4): short and flattened, with radial wrinkles near apex. Uterus: fairly elongate, sacculate. Free oviduct: glandular ring around apex not swollen; long and slender, gradually enlarged towards base. Spermatheca: short type with slender stalk. Vagina: very short; glandular collar extremely narrow and without pigment. Vas deferens: epiphallus swollen, connected to lower half of penis by fans of fibers; penial papilla (fig. 3) a large, flat, almost sessile, superficially plicate body near apex of penis. Penis: short, stout, and thick-walled with conical apex; internal wall with fine, undulate, transverse folds to below papilla and with low, broad, longitudinal thickenings in lower half. Penial retractor: origin near right edge of diaphragm opposite middle of uterus; insertion on side of penial apex. Cloaca: extremely short; external opening as in *Retinella.*

Mantle (right columellar) muscle: heavy. Principal columellar retractor gives off: 1) buccal muscle which is almost separate, 2, 3) right and left free retractors near origin and continues as 4) large tail fan. Free retractors: each gives off small tentacular muscle, which divides as usual; remainder coalesces with tail fan; right mass with heavy band to cloaca. Right tentacular retractor: free from genitalia.

Jaw: thin, transparent, and horn-colored; central plaits represented by weak thickenings which project to form irregular point at middle of cutting edge. Radular formula (fig. 2): 69–6–1–75; 102 rows counted. Laterals: bicuspid but with prominent entoconal plate. Marginals: all simply aculeate, outer ones very small. Salivary glands: lens-shaped, 1½ times length and more than twice width of buccal mass; right one more posteriad; ducts about as long as glands.

M. (*Omphalinella*) *veracruzensis veracruzensis* (Pfeiffer)

Plate 10, figs. 1 to 4

Zonyalina jalapensis S. und P. (1880: 16, pl. 8, f. 5, pl. 9, f. 7, 19), anatomy of subspecies.

Type locality: Córdoba, V. C. AD, I, ad, 1, 3–6; Atoyac to Sumidero, 1300–3400 ft.; adults quite infrequent, mainly on ground; juveniles often climb into lower vegetation.

Adults of this species have a very narrowly reflected peristome; they are more variable than usual in shape and size. Although the examples from Sumidero are few, the fact that one of the adults is smaller than any of those from Córdoba seems rather significant.

		Shell		Whorls
Peñuelo (st. 3)				
means, 5 adults.....	6.4	178(11.3)	151(9.6)	4.9
minima	5.7	168(10.1)	140(8.5)	4¾
maxima	7.3	190(12.7)	160(10.9)	5
Córdoba (st. 4, 5)				
means, 17 adults.....	6.6	176(11.6)	150(9.9)	4.87
minima	5.9	167(10.4)	143(9.0)	4¾
maxima	7.3	183(12.9)	159(10.9)	5
Sumidero (st. 6)				
means, 2 adults.....	5.8	181(10.5)	159(9.2)	4¾
measurements	5.4	183(9.9)	163(8.8)	4¾
	6.2	179(11.1)	155(9.6)	4¾

The differences between the shells of typical *veracruzensis* and the subspecies *jalapensis* appear very slight. The section *Omphalinella* (in *Patulopsis*) also may include: *M. sallaeanus* (Mart.), said to be from Córdoba, *M. sculptus* (Mart.) from Guerrero and *M. montereyensis* (Pils.) from Nuevo León, with its subspecies *victorianus* (Pils.) from Tamaulipas. The following anatomical notes are founded on animals from near Córdoba (mainly station 4); the structure is fundamentally similar to that in *M. bilineatus* and only differences will be noted.

Animal: mainly light colored but dorsum of head and exterior surfaces of neck-lappets darker, with a few scattered spots on sides of foot and partially confluent series along lower pedal groove; tail pore a large transverse opening across deep mid-dorsal groove which weakly emarginates tip of foot; middle zone of sole narrow. Mantle collar (fig. 2): thick and quite deep; right neck-lappet high, left one large and protuberant, left accessory small and fusiform. Lung wall: about twice as long as its base and a little less than twice length of kidney; principal vein with large tributaries on both sides; surface with big black blotches over kidney and along right sides of hindgut and parallel arm of ureter and with scattered smaller spots in meshes of venation. Kidney: about 1½ times as long as its base, or length of pericardium.

Ovotestis: consisting of 5 masses of irregularly clavate alveoli imbedded in lower ⅔ of apical hepatic lobe. Talon (fig. 1): ovoid with knobby exterior; carrefour slender. Uterus: light brown. Free oviduct: apical, glandular collar swollen. Spermatheca: sac large; apex of stalk very slender but basal ¾ greatly enlarged and with thick, internally plicate wall. Vagina: short but stout; glandular collar apparently present but very indistinct. Prostate broad and diffuse. Vas deferens: uniformly slender; terminal opening in a pilaster, some distance below apex of penis. Penis (fig. 3): very stout and short-pyramidal; internally with a huge, V-shaped fold on dorsal side that divides lumen into an apical (epiphallar?) and basal compartments; entire internal surface complexly plicate. Penial retractor: short and stout; origin lower, insertion on penial apex.

Retractor system: tentacular muscles relatively heavier. Jaw: growth-lines stronger and surface with more evident, fine radial lines (in addition to weak central plaits). Radular formula (fig. 4): 63–6–1–69; 87 rows counted. Salivary glands: flattened lanceolate, about twice as long as buccal mass; ducts ⅔ as long as glands.

M. (*Patulopsis*) *carinatus* (Strebel und Pfeffer)

Plate 10, figs. 5 and 6

P. carinatus S. und P. (1880: 17, pl. 8, f. 6, pl. 9, f. 8, 20), anatomy.

Type locality: Pacho Woods, Jalapa, V. C. AB, I, a, 33, 34, 41; above Necaxa, 4700–5500 ft.; infrequent under leaves, usually near rock ledges.

The sharp growth-ribs of this species begin on the embryonic whorls, although the first half-whorl is relatively smooth. The peristome appears to remain simple and sharp, even in sexually mature individuals; the dimensions given below are simply those of large specimens; those from station 33 are exceptionally depressed.

		Shell		Whorls
Station 33				
2 largest	4.6	189(8.7)	169(7.8)	4¾
	5.0	180(9.0)	162(8.1)	5
Station 41				
means, 5 shells	4.9	173(8.5)	158(7.8)	4.9
minima	4.6	167(7.7)	156(7.3)	4¾
maxima	5.1	175(8.9)	161(8.2)	5
Cotype measurements				
(Strebel und Pfeffer)	5.3	170(9.0)	140(7.4)	4¾
	4.9	184(9.0)	149(7.3)	4¾

The anatomical notes given below are mainly founded on animals from station 41. Their structure is very similar to that of *M. veracruzensis* and only distinctive details are mentioned.

Animal: sides of foot with more conspicuous groups of black spots; middle zone of sole grayish; lung wall mainly black but mantle collar light and vicinity of kidney chalky white (parasites?); mantle over stomach with large patches of chalky white and alternating darker areas; liver orange with superficial reticulation of black lines. Foot: relatively short and broad; pedal pore in a prominent, mid-dorsal

groove which also renders tip of tail weakly bifid. Mantle collar: left lappet less prominent (but not bifid!), left accessory shorter but broader. Lung: more elongate, length about 3 times its width or length of kidney; venation indistinct outside of principal vein and a few tributaries. Kidney: about 1½ as long as its width, or length of pericardium.

Talon (fig. 6): simpler; carrefour stouter. Free oviduct: less elongate, almost uniform in diameter; opening into side of basal enlargement of spermathecal stalk, which makes nominal vagina longer. Epiphallar opening: above right edge of fold which encircles penial apex. Penis (fig. 5): broad apically and tapered basally; internally with a very prominent, glandular fold, which forms an elliptical zone just below apex and with a less prominent, almost complete, transverse one a short distance below; basal half with internal pilasters. Penial retractor: very short and stout. Jaw: even thinner; growth-lines less pronounced; central plaits fairly distinct. Radular formula (cf. fig. in S. and P.): 36–5–1–41; 71 rows counted; series of minute outer marginals reduced to one or two.

Genus *Hawaiia* Gude

Hawaiia Gude (1911, Proc. Mal. Soc. London 9: 272) type by original designation *Helix kawaiensis* Pfr. (1854, Proc. Zool. Soc. London: 52) from Kauai, Hawaiian Islands; type by (invalid) subsequent designation of Gude (1911, op. cit., later but undated and unpaginated erratum) "*Helix hawaiiensis* Ancey" [=(?) *Vitrea hawaiiensis* Anc. (1904, Proc. Mal. Soc. London 6: 120) from Hawaii]; Cooke (1921, Occ. Pap. Bishop Mus. 7: 271) a lucid discussion of this nomenclatorial obscurity.

Pseudovitrea H. B. B. (1928: 24 and 25) type by original designation *Helix minuscula* Binn. (1840, Jour. Boston Soc. Nat. Hist. 3: 435) but from Cecil Bay, Michigan.

Through the kindness of Dr. C. Montague Cooke, I have been able to examine the anatomy of specimens of *H. kawaiensis* from Halawa, Molokai, collected Dec. 31, 1923 (Bishop Museum no. 76132). In regard to these, Dr. Cooke writes: "Whether the material I am sending you is Pfeiffer's species or not I do not know; but I have compared specimens with

those which are in the British Museum and feel pretty sure of the identification. . . . I do not doubt for a moment that you will find this species to be *minuscula,* and that it was carried here (Hawaiian Islands) at some early date." I can find no salient differences between the soft parts of these Pacific individuals and those from examples of typical *minuscula* collected in northern Michigan. The Hawaiian shells appear to attain a slightly larger size than is usual, but do not develop the harsher sculpture which is one of the characters of both the forms *alachuana* and *neomexicana* from southern United States and Mexico. Despite the haphazard ludification in its chrismal miscarriage, *Hawaiia* Gude (founded on *H. minuscula,* var.) is a valid onym and must replace *Pseudovitrea* as a generic name.

Hawaiia minuscula neomexicana (Cockerell and Pilsbry)

Zonitoides neomexicanus Ckll. and Pils. (1900, Naut. 13: 114). *Punctum pygmaeum albeolum* Dall (1926, Proc. Cal. Acad. Sci. 15: 481, pl. 35, f. 18, 19), Maria Magdalena Island, Jalisco, Mexico. *Pseudovitrea minuscula neomexicana* H. B. B. (1929, Proc. Acad. Nat. Sci. Philadelphia 81: 262, pl. 10, f. 7–9), shell and anatomy of Necaxa specimens.

Type locality: Dripping Spring, Organ Mts., New Mexico. CD, III, a, 34–36, 52, 53; Necaxa, 3000–5000 ft.; quite common in leaf humus.

Material from New Braunfels, Texas, contains both *neomexicana* and *alachuana;* all the Necaxa examples appear to be the former. Immature individuals of either of these subspecies superficially resemble typical *minuscula* and are often identified as the northern form, although the latter has considerably weaker ribs and spirals. I have examined material of Dall's *albeolum* in the U. S. National Museum and from the California Academy; the paratypes also include shells of *Striatura meridionalis* and juvenile specimens of some *Punctum.*

Pycnogyra berendti (Pfeiffer)

P. berendti H. B. B. (1928: 27, pl. 5, f. 5–10), anatomy of Necaxa animals.

Type locality: Mirador, V. C. ABCD, I, a, 33, 34, 37, 41, 54; Necaxa, 2625–5500 ft.; quite infrequent in leaf humus, usually near rock ledges.

This species appears to attain a greater number of whorls and consequently a larger size at the higher elevation (stations 33 and 37) near the fog zone.

		Shell		Whorls
Station 37, largest.....	2.5	180(4.5)	172(4.3)	8

Striatura (*Pseudohyalina*) *meridionalis* (Pilsbry and Ferriss)

Plate 11, figs. 2, 4 and 5

Vitrea milium meridionalis P. and F. (1906: 152).

Type locality: along Guadalupe River, above New Braunfels, Comal Co., Texas. ABCD, III, a, 33–35, 41, 52, 53; Necaxa, 3000–5500 ft.; infrequent in leaf humus. Range of ANSP. material: Pennsylvania (Northampton, Beaver, Bucks, Montgomery, Philadelphia, and Chester Co.), New Jersey (Burlington, Camden, Atlantic, and Cape May Co.), Delaware (Kent and Sussex Co.), Maryland, Virginia, Kentucky, Tennessee, North and South Carolina, Florida, Alabama, Texas, Arizona, and New Mexico; also near Orizaba, Mexico.

Range of ANSP. material of *S. milium* (Morse): Canada (Prince Edward Island), Maine, Massachusetts, New York, Michigan, Ohio (Kent Co.), Illinois (subfossil), Pennsylvania (McKean, Monroe, Berks, and Delaware Co.), and New Jersey (Warren and Morris Co.).

A few months ago, Mr. Hugh Watson, of Cherryhinton, England, asked me to send him some animals of *S. milium*. I collected and sent him Philadelphia specimens of what had

universally been called that species. He wrote back that the shells looked more or less like *S. milium,* but that the animals and radulae were closer to those of *S. exigua,* and suggested that they might be *S. meridionalis.* Subsequent study shows that both *S. meridionalis* and *S. pugetensis* (Dall) belong in the subgenus *Pseudohyalina* and are more closely related to *S. exigua,* either on conchological or anatomical grounds, than to *Striatura* (*s. s.*) *milium.* Examination of most of the ANSP. material of *S. milium* and *S. meridionalis* under considerable magnification has resulted in the foregoing ranges.

Key to the Known Species in Striatura

A. Penis with circlets or rows of spines near apex; central of radula not much larger than first lateral; embryonic whorls of shell with distinct spiral ridgelets which begin at the very apex; later whorls gradually expanding, with oblique riblets superimposed on the growth-wrinkles.....Subgenus *Pseudohyalina* Morse

B. Shell larger (maj. diam. 2.5 mm.); oblique riblets much stronger than growth-wrinkles; northeastern species.....*S. exigua* (Stimpson)

BB. Shell smaller; oblique riblets about as strong as growth-wrinkles so that two appear to anastomose

C. Shell sculpture more widely spaced; southeastern species.....*S. meridionalis* (P. and F.)

CC. Shell sculpture very closely spaced; western species.....*S. pugetensis* (Dall)

AA. Penis without circlets of spines; central much the largest tooth in radula; embryonic whorls with weak spirals which begin some distance below apex; later whorls more rapidly expanding, without oblique riblets but with beaded growth-wrinkles

D. Epiphallus well-developed; penis with apical dart-sac, papilla, and dart; radula with more than one bicuspid marginal (as in *Pseudohyalina*); shell small, with less rapidly expanding whorls; one northeastern species...Subgenus *Striatura* s. s. *S. milium* (Morse)

DD. Epiphallus and penis almost vestigial; radula with only one bicuspid marginal; shell larger (maj. diam. 2.5 mm. or more), with more rapidly expanding whorls; one northeastern species.....Subgenus *Striaturops* H. B. B. *S. ferrea* Morse

In the United States, *S. meridionalis* does not appear to endure the winter in the adult state. Specimens from Tennessee, collected during the last week in March and the first of April, are not fully mature; one out of five topotypes, obtained the last week in June, approaches maturity. On the other hand, several animals from Tennessee, collected in July and August, are sexually ripe. The following anatomical notes are mainly based on animals from Necaxa; only salient differences from the structure in *S. exigua* are given.

Uterus: more markedly sacculate basally. Free oviduct (fig. 4): more swollen and relatively shorter. Spermatheca: sac clavate, imbedded near base of albumen gland; stalk expanded at fork to form a small capsule which stretches across base of penis and is attached to cloaca; opening into cloaca slightly below penis (*i.e.*, vagina is a minus quantity). Prostate: about half length of uterus. Vas deferens: relatively long. Epiphallus: proportionately smaller; no distinct penial papilla. Penis: very small and short, little more than a subspherical, very thick-walled excrescence on side of oviduct; internally with two dome-shaped bosses, one on either side of epiphallar opening, each of which bears an S-shaped row of spines; those in outer arm of S stouter and more distant than remainder (fig. 2). Cloaca: long and thick-walled. Radular formula (fig. 5): 11–5–5–1–21; 61 rows counted. Marginals: innermost 5 bicuspid, intergrading with laterals.

One of the Mexican animals has the cloaca, penis, and part of the free oviduct exserted. The everted penis looks like a dome-shaped boss (fig. 2). I suspect that the cloaca acts as the major portion of the copulatory organ and that the penis proper serves only as its glans.

For comparison, *S. pugetensis*, of which I have better and more numerous specimens, has been dissected; the following notes are based on animals from near Piedmont (Lake Crescent), Clallam Co., Washington. Their genitalia are very similar to those in *S. meridionalis*, but the spermathecal sac is fusiform and lies imbedded near the base of the stomach

and on the side opposite the albumen gland. Also, the penis (fig. 3) is armed with two elliptical circlets of small spines, one on either side of epiphallar opening, and with a single, large, stouter spine near the basal edge of each ring. In several individuals, the cloaca is exserted with the everted penis on its tip and certainly appears to substantiate the hypothesis advanced for the condition in *S. meridionalis*. This peculiar relationship between the penis and cloaca seems to present additional evidence in favor of my earlier suggestion that *Pycnogyra* may represent an approach to the Gastrodontinae and throws new light on a possible method of origin for the bifurcate spermathecal stalk in that subfamily.

I have also examined a single animal of *S. ferrea* from Limestone Cove, Unicoi Co., Tenn.; its genitalia are much like those of examples from northern Michigan, although its penis and epiphallus appear slightly less vestigial.

Zonitoides (*Zonitellus*) *arboreus* (Say)

Type locality: probably Philadelphia, Pa. CD, III, ac, 4, 35, 36, 51–53; Córdoba, 2650 ft.; Necaxa, 3000–4925 ft.; infrequent, under dead leaves and on logs.

The shell from Córdoba is larger, relatively higher and has a larger umbilicus (approaching *hoffmanni*) than most northern examples. On the other hand, those from Necaxa are exceptionally small, which renders especially difficult their separation from specimens of *Retinella subhyalina*. The anatomy of Necaxa animals seems quite similar to that of northern individuals.

Systrophiidae

Miradiscops puncticipitis (Pilsbry)

M. puncticipitis H. B. B. (1929: 253, pl. 8, f. 5, 6), anatomy of Necaxa animals.

Type locality: Chama, Guatemala. AD, III, a, 1, 3, 4, 6, 53, 54; Atoyac to Sumidero, 1300–3400 ft., very infrequent; Necaxa, 2625–3000 ft., frequent, in leaf humus.

The shell of this species looks like a miniature edition of that of *Hawaiia minuscula neomexicana,* which inhabits similar places.

Miradiscops opal (Pilsbry)

M. opal H. B. B. (1929: 252, pl. 8, f. 2–4), anatomy of Necaxa animals.

Type locality: Polvón, Nicaragua. D, III, a, 3, 4, 53, 54; Córdoba, 2625–3000 ft., and Necaxa, 2625–3000 ft.; quite rare, in decaying leaves.

These northern examples have deeper sutures, smaller whorls (*i.e.,* potentially smaller shell), and much weaker sculpture than the type of the species. The last feature weakens the opalescence of unmagnified shells, although it is still visible on the apical side.

Limacidae

Several species of European slugs appear to be widely distributed in Mexico, but a rather careful study of the literature as well as the material at hand shows no conclusive evidence for the existence of any native Mexican Limacidae. In fact, I am inclined to suspect that this applies to the western hemisphere.

Limax maximus Linné

L. maximus Simroth (1885, Zeitschr. wiss. Zool. 42: 204, pl. 8, f. 1–11); Hesse (1926, Abh. Arch. Mollusk. 2–1: 10), etc., anatomy of European examples.

Type region: western Europe. C, III, ab, 11, 12; Guajimalpa to El Desierto, 8525–9850 ft.; frequent under rotting leaves of maguey and on wall of old monastery.

The anatomy of the specimens dissected agrees very closely with Simroth's and subsequent descriptions and figures. Their coloration varies towards the *fasciatus* pattern.

Limax (*Limacus*) *flavus* Linné

L. variegatus Simr. (1885: 214, pl. 8, f. 17–19). *L. flavus* Hesse (1926: 10) etc.; anatomy of European animals.

Type region: western Europe. C, II, a, 22; Huachinango, 4590 ft.; collected by Dr. Rodriguez in gardens of town.

The identification has been verified by dissections. These examples appear to belong to the typical color form.

Deroceras laeve (Müller)

Plate 11, figs. 1, 6, and 7

L. laevis Lehmann (1873, Schnecken Stettins: 42, pl. 8, f. 10). *Agriolimax laevis* Lessona e Pollonera (1882, Mem. Acc. Torino 35: 93, pl. 2, f. 22, pl. 3, f. 6); Simroth (1885: 222, pl. 9, f. 16–22); Taylor (1904, "Land Freshw. Moll. B. I." II: 121, f. 129, 135, 136); Hesse (1926: 21–24), anatomy of European specimens.

L. gracilis Raf. (1820, Ann. Nat. I: 10), Kentucky. *L. campestris* Binn. (1841, Proc. Boston Soc. Nat. Hist. I: 52), New England to Missouri; Leidy (1851, Terr. Moll. U. S. I: 250, pl. 2, f. 5, 6).

L. semitectus Mörch (1857, Jour. de Conch. 6: 282, pl. 10, f. 7), founded on Oersted's fig. of a Central American slug. *Krynickia americana* Tate (1870, Amer. Jour. Conch. 5: 154, pl. 16, f. 1), Javali in Chontales, Nicaragua. *L. guatemalensis* Crosse et Fischer (1870, Jour. de Conch. 18: 297), Tonicapán, Guatemala; F. et. C. (1872, Miss. Mex. I: 181, pl. 9, f. 1–5). *L. stenurus* S. und P. (1880: 21, pl. 9, f. 11, 15, pl. 10, f. 3), without locality. *L. jalapensis* S. und P. (1880: 22, pl. 10, f. 5), Jalapa, V. C. *L. berendti* S. und P. (1880: 22, pl. 9, f. 10, pl. 10, f. 4, pl. 15, f. 3), Coban, Guat. *Agriolimax guatemalensis motaguensis* Ckll. (1914, Naut. 28: 57, pl. 2, f. 4), Quirigua, Guatemala.

Type region: Denmark. C, III, ab, 11–13, 23; San Juan Teotihuacán, Guajimalpa, and El Desierto, 7510–9850 ft., under rotting leaves of maguey and on walls of monastery; Necaxa, 4265 ft., on wet basalt cliffs.

A study of the literature on slugs tantalizes one with the paradox that the United States is about the only region of the habitable globe from which *D. laeve* is never reported, although this country has probably naturalized more European immigrants, of one kind or another, than all of the rest of the world taken together. A comparison of the publications on this ubiquitous species with the material before me presents convincing evidence that one species occurs in both Mexico and the United States and that none of the describers or revisers of the names included in the foregoing synonymy has

ever contributed satisfactory proof towards the separation of any of them from *D. laeve* of Europe. At least interesting in this connection is F. C. Baker's report, in his "Life of the Pleistocene" (1920, *Univ. Ill. Bull.* 17, no. 41: 144) of the shell plates of "*A. campestris*" from *only* one Recent deposit ("the marl beds possibly still forming in some places") and that this also contains another ("Limacid, spec. indet.") plate which is 5 mm. long. In case future workers should find that the differences, noted below, between American examples and Simroth's figures are constant, *D. gracile* is the prior name for the New World form, but *D. campestre* (as elaborated by Leidy) has the first strictly recognizable description; in fact, Leidy's anatomical studies on *agreste* and *campestre* give the earliest adequate data for any member of the genus. My tentative inclusion of all of the Central American names in one synonymy is simply an attempt to collate this remarkable sequence of indeterminate definitions; *L. cobanensis* C. et F. (1872, *J. de C.* 20: 59) from Coban, Guatemala, is omitted only because the length given (40 mm.) is rather large for the present species. E. von Martens (1898: 347) has already taken the same stand in regard to many of them.

Simroth has shown that European examples of *D. laeve* are protogynous and the same appears to be true for American specimens. My animals from El Desierto and Necaxa have well-developed female organs and rudimentary penes (*cf.* type fig. of *stenurus*) but two of those from San Juan Teotihuacán and Guajimalpa have mature, hermaphroditic genitalia. A specimen from Snohomish Co., Washington, collected Aug. 16, and another from Adams Co., Idaho (Sept. 12–15), also have well formed penes of similar type. On the other hand, a large series from Cheboygan Co., Michigan (mainly during July), are all in the female stage. Taylor's hypothesis that American specimens always retain the immature (female) condition does not take into account Leidy's excellent figure of mature genitalia. My dissections agree with Simroth's figures in everything except the following:

Vas deferens (fig. 7) : terminal orifice near middle of penial flagellum, without definite verge. Penis: divided by a sphincteric contraction into two regions, an apical flagellum (about $\frac{3}{5}$ total length) and a basal penis proper. Flagellum (or epiphalloid chamber) : stout and digitiform, often coiled into a short spiral; wall slightly thicker than in penis proper and internally complicated by two, heavy, glandular pilasters and numerous, very fine, irregularly longitudinal ridges (fig. 6). Penis proper: basal half slender and often contracted, internally with very minute, longitudinal thickenings; apical half swollen, internally with a large, mammiform stimulator (fleshy dart-papilla) projecting from wall, which apically is also wrinkled transversely. [In extreme contraction, the apical half of the penis proper, with its enclosed stimulator, remains relatively large and prominent, much as represented in one of Lehmann's figures.] Penial retractor: origin from anterior field of true diaphragm; insertion on opposite side of flagellum from entrance of vas deferens and at a lower level (usually at least halfway towards flagellar base).

Radular formula of Guajimalpa animal (fig. 1) : 25+13+1+38; 98 rows counted; few inner and more outer marginals bicuspid, intermediate ones mainly unicuspid. San Juan Teotihuacán (also mature): 32+17+1+49; 97 rows counted; most marginals with some trace of ectocones. Necaxa (female): 29+(15–16)+1+(44–45); 109 rows counted; central markedly asymmetric; most marginals with at least a definite trace of ectocone. Northern Michigan (4 females): (30–31)+(14–15)+1+45; 102 rows counted, innermost marginals bicuspid, remainder unicuspid or weakly angulate; (27–28)+(15–16)+1+43; 104 rows counted, marginals as in preceding; (28–29)+(16–17)+1+45; 102 rows counted, inner and occasional outer marginals with well-formed ectocones; (27–28)+(16–17)+1+44; 103 rows counted, marginals as in preceding but bicuspid outer ones more frequent. Centrals and laterals: always tricuspid.

As noted in the foregoing, these examples have a relatively longer, less hammer-shaped flagellum than that shown by Simroth. However, the figures of Lehmann and of Lessona e Pollonera do not show this peculiarly transverse development, and I suspect that it represents a rather unusual phase of contraction. In addition, the penial retractor in American examples inserts considerably lower on the flagellum than indicated by Simroth. This muscle appears to arise as an accumulation of strands in the loose connective tissue between the genitalia and the diaphragm; in one of my specimens with a quite mature penis, it is represented by a very slender band of tissue, which is loosely attached by fine, radiating fibers, both at its origin and at its insertion. On account of its late development, variation in its attachment would be readily explicable, although, in the four mature American specimens examined, it invariably inserts below the entrance of the vas deferens. ANSP. animals from Dublin, Ireland (Dr. R. F. Scharff), have rudimentary penes (like Scharff's published figure), and I have been unable to examine mature European material.

The development of ectocones on the radular marginals is extremely variable. As previously suggested, the greatest degree of specialization in Zonitoid radulae appears to center on the larger marginals, so that primitive conditions may be retained either towards the middle or near the margin of the ribbon. As a rule, a series of marginals between the inner and outermost ones are unicuspid in *D. laeve,* but almost all these may retain a slight angle at the usual position of the ectocone, or all except the innermost marginals may be unicuspid (two Michigan animals). Teeth with well developed ectocones often occur side by side or even in the same longitudinal row with practically unicuspid denticles, especially near the outer margins of the ribbon, and occasionally tricuspids are present. The systematic value of this vestigial character is very dubious. Also, previous experiences with W. G. Binney's radular studies make me highly skeptical of his alleged bicuspid laterals in "*A. campestris.*"

The animals from around Mexico City appear to average slightly larger than those of northern United States. Some specimens are as dark as Mörch's figure of *semitectus,* but usually the more mature animals are lighter and have a thinner mantle.

Aspidophorus (*Milax*) *gagates* (Draparnaud)

Amalia gagates Simr. (1885: 230, pl. 10, f. 14). *Milax gagates* Hesse (1926: 32, 33) etc., anatomy of European specimens.

Type region: France. C, 11, II, b; El Desierto, 9850 ft.; one adult on wall of old monastery.

The anatomy of this example agrees with Simroth's account in most particulars but the spermatheca is less evenly rotund and the considerably larger stimulator is rolled into a spiral and has scattered, thorn-shaped papillae near tip of concave side. Through the kindness of Dr. Pilsbry, I have also been able to examine animals of "*Amalia hewstoni*" from Oswego, Oregon (John A. Allen!); these have the same anatomy, but the spermatheca happens to be more evenly rotund, as in Simroth's figure. The Mexican individual is almost black like Mediterranean specimens (var. *bedriagae*), but the Oregonian ones are lighter (typical *gagates*).

Corrections for Part I

p. 36, lines 10 and 13 of key. Replace *Atoyac* by *Schasicheila* s. s. and *Schasicheila* s. s. by *Misantla* H. B. B. (1928, *Naut.* 42: 36).

p. 37, 5 lines from bottom. Change edipermal to epidermal.

pp. 39 and 40, species headings. Delete *Atoyac.*

pp. 40 and 41. *S. nicoleti* and *S. misantlensis* belong in the subgenus *Misantla.*

pp. 43 to 45 and plate 5. Change specific names to agree in gender with *Pyrgodomus,* which is a feminine noun (*e. g., P. microdina abdita*).

p. 54. Delete the "Addendum" (origin unknown to me!).

PLATE VII

Uppermost scale represents .1 mm. and is for fig. 6, next (.5 mm.) is for fig. 9, third (2 mm.) is for fig. 11, fourth (2 mm.) is for fig. 13, fifth (1 mm.) is for fig. 1, sixth (1 mm.) is for fig. 14 and lowest (.5 mm.) is for fig. 3.

Figs. 1, 2. *Pupisoma comicolense* (station 53). Frontal view and umbilical outline of type shell.

Figs. 3–5. *Punctum* (*Toltecia*) *vitreum* (New Braunfels, Tex.). Frontal view (apical whorls shown in outline) and umbilical and apical outlines of type shell.

Fig. 6. *P. vitreum.* Sculptural details on last whorl of a paratype.

Figs. 7–9. *Radiodiscus proameri* (station 35). Frontal view and umbilical and apical outlines of type shell.

Figs. 10, 11. *Habroconus trochulinus* (station 53). Frontal and apical outlines of a large shell.

Figs. 12, 13. *Habroconus selenkai* (station 54). Frontal and apical outlines of a large shell.

Figs. 14–16. *Guppya sterkii punctum* (station 54). Umbilical, apical and frontal outlines of type shell.

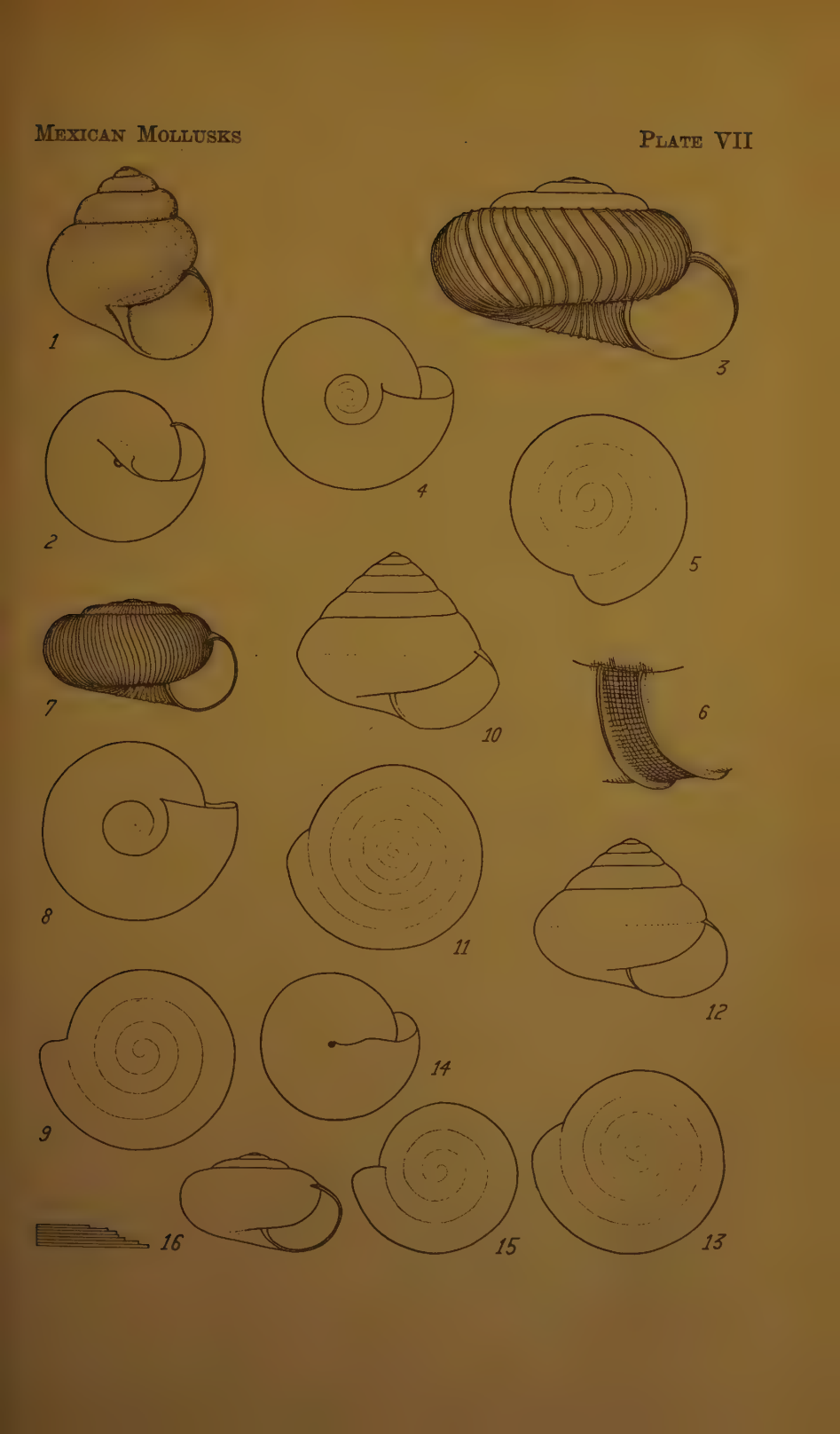
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PLATE VIII

Uppermost scale represents 10 microns and is for fig. 1, next (as 5 mm.) is for fig. 6 and (as 1 mm.) for figs. 2 and 5, third (as 200 microns) is for fig. 1T and (as 5 mm.) for fig. 4, and lowest (5 mm.) is for fig. 3.

Fig. 1. *Pallifera costaricensis crosseana* (station 4). Radula: central and first lateral in natural relations; also 14th, 20th, 21st, and 22nd teeth. Diagram of right half of transverse row (T) shows positions of each 7th tooth.

Fig. 2. *P. costaricensis alticola* (station 11). Jaw of type (badly and unevenly worn).

Fig. 3. *P. costaricensis alticola.* Penis, cut open longitudinally and pinned flat.

Fig. 4. *P. costaricensis alticola.* Internal view of pallial complex.

Fig. 5. *P. costaricensis crosseana* (station 6). Jaw (comparatively unworn).

Fig. 6. *P. costaricensis alticola.* Dissected genitalia; convolutions of spermoviduct scarcely disturbed.

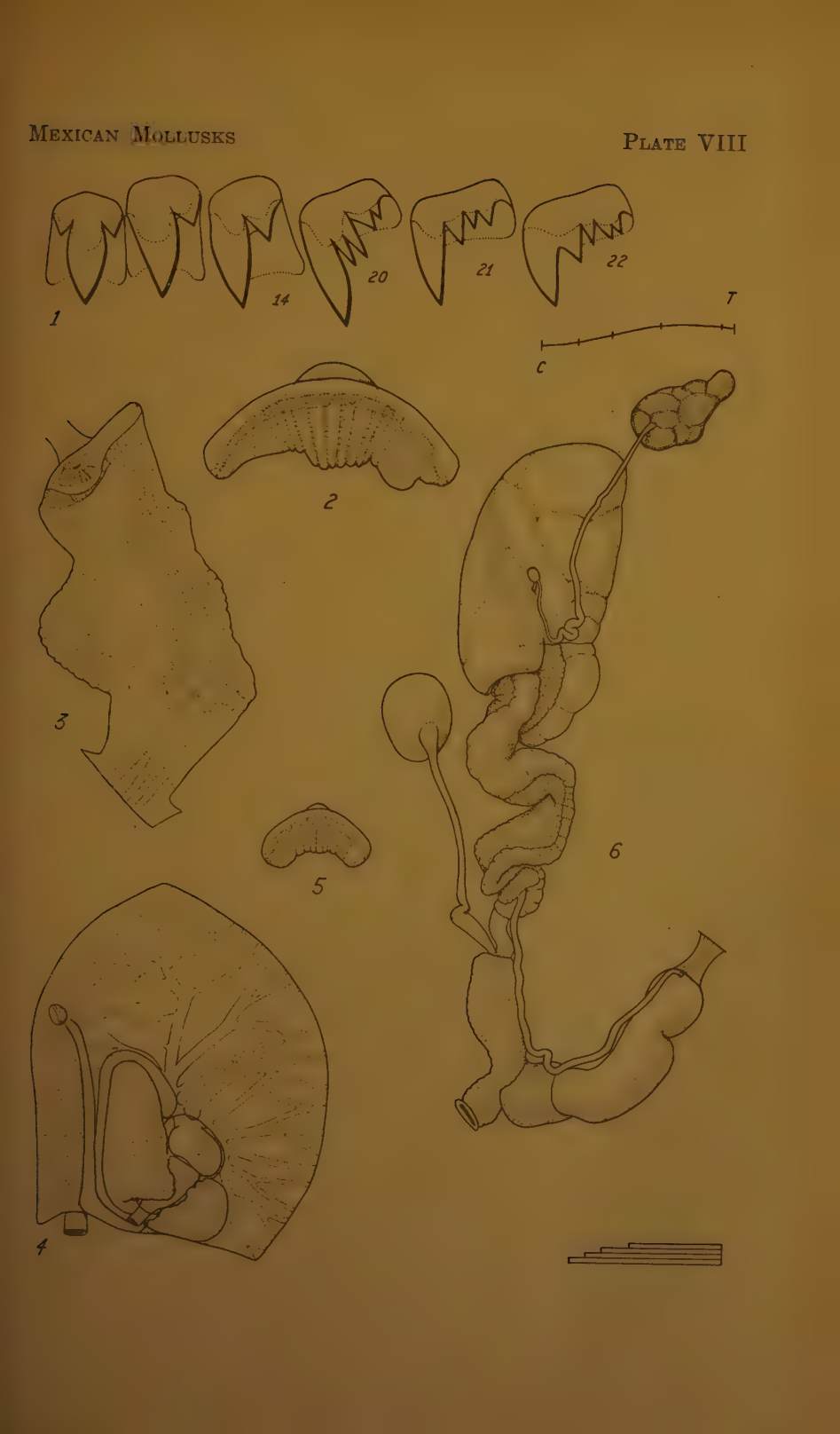
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PLATE IX

Uppermost scale (as representing 50 microns) is for fig. 2, (as 500 microns) for fig. 2T and (as 1 mm.) for fig. 3, next (5 mm.) is for fig. 4, and lowest (5 mm.) is for fig. 1.

Fig. 1. *Mesomphix* (*Omphalina*) *lucubratus caducus* (station 4). Terminations of dissected genitalia.

Fig. 2. *Mesomphix* (*Zonyalina*) *bilineatus* (station 6). Radula: central and first lateral in natural relations; also right half of transverse row with widths of central and laterals and positions of each 7th marginal indicated.

Fig. 3. *M. bilineatus.* Penis; cut open longitudinally and pinned flat. Y-shaped opening of vas deferens shows in penial papilla and crescentic vaginal orifice near bottom of figure.

Fig. 4. *M. bilineatus.* Dissected genitalia (ovotestis omitted).

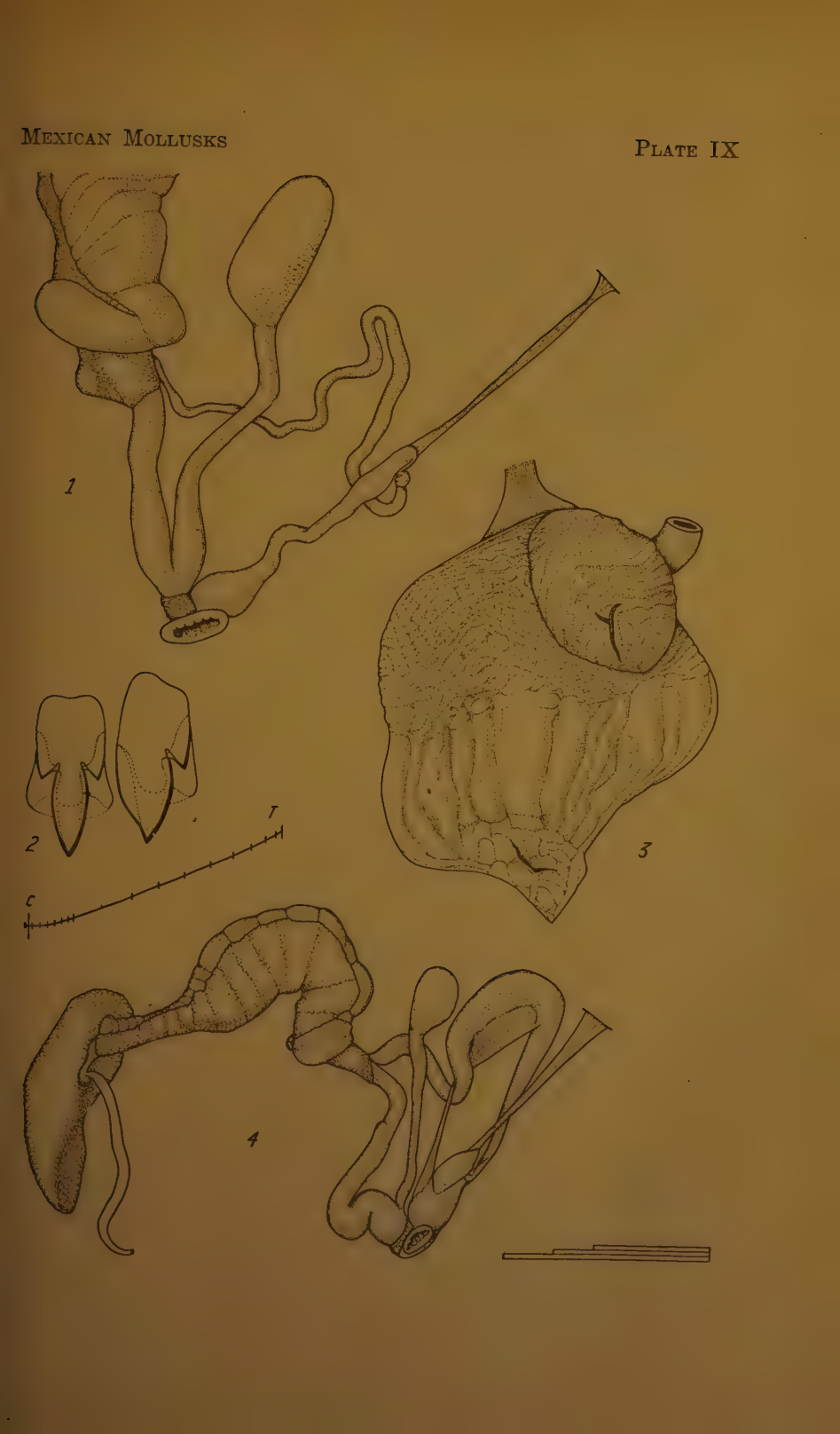
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PLATE X

Uppermost scale (as 1 mm.) is for fig. 3 and (as 2 mm.) for fig. 6, next (as 3 mm.) is for fig. 1 and (as 1 mm.) for fig. 5, third (50 microns) is for fig. 4, fourth (5 mm.) is for fig. 2, and lowest (.5 mm.) is for fig. 4T.

Fig. 1. *Mesomphix* (*Omphalinella*) *veracruzensis veracruzensis* (station 4). Dissected genitalia (ovotestis omitted) with penis twisted outwards.

Fig. 2. *M. veracruzensis veracruzensis.* Internal view of pallial complex (only larger veins shown).

Fig. 3. *M. veracruzensis veracruzensis.* Penis, opened longitudinally and pinned flat; opening of vas deferens shows as slit near apex.

Fig. 4. *M. veracruzensis veracruzensis.* Radula: central and first lateral in natural relations; also diagram of right half of transverse row (T) with widths of central and laterals and positions of each 7th marginal indicated.

Fig. 5. *Mesomphix* (*Patulopsis*) *carinatus* (station 41). Penis, as in fig. 3; opening of vas deferens hidden under inner edge of elliptical fold.

Fig. 6. *M. carinatus.* Dissected genitalia.

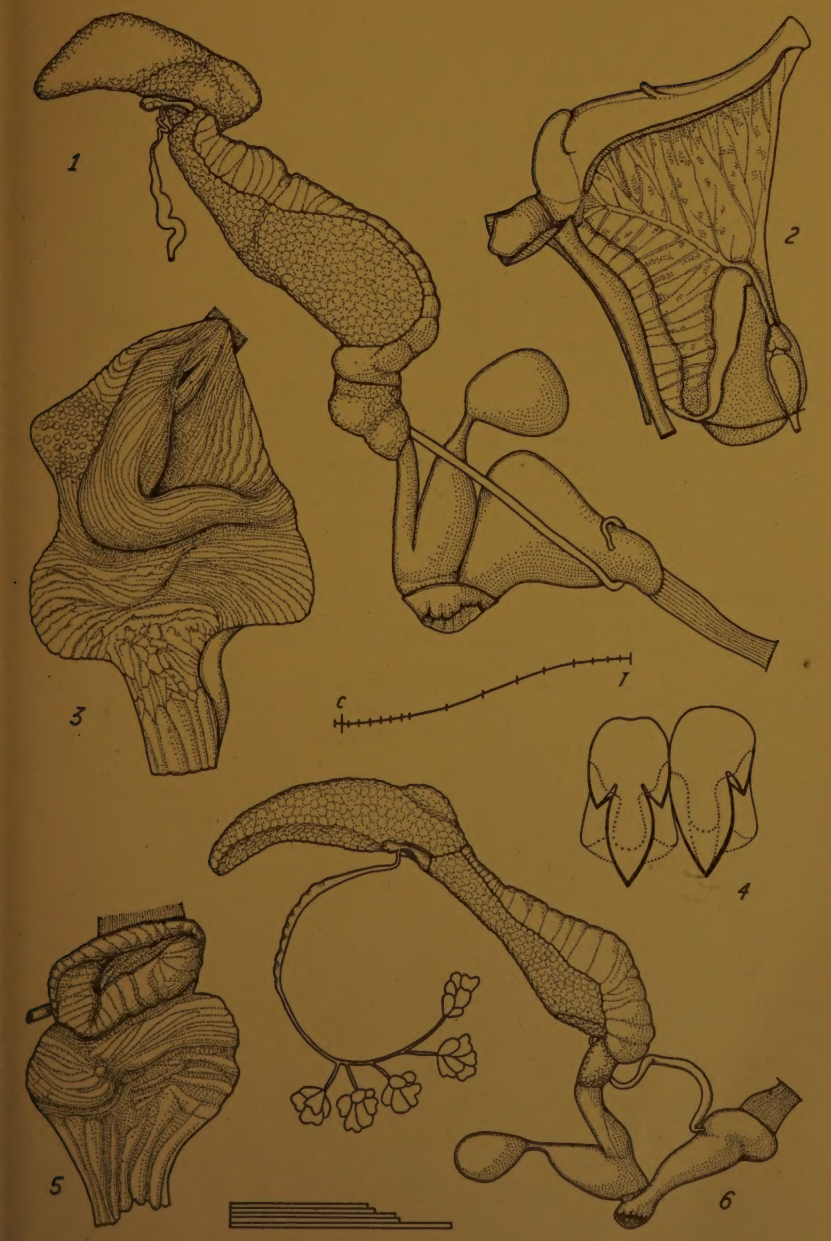
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PLATE XI

Uppermost scale represents 10 microns and is for fig. 1, next (10 microns) is for fig. 5, third (as .2 mm.) is for fig. 1T, (as 50 microns) for fig. 5T and (as 2 mm.) for fig. 7, fourth (.2 mm.) is for figs. 2 and 3, and lowest (.5 mm.) is for fig. 4.

Fig. 1. *Deroceras laeve* (station 12). Radula: central and first lateral, 13th to 15th teeth and 33rd and 34th teeth, each denticle in natural relations with others of its group; also another 33rd and a 34th tooth and diagram of right half of transverse row (T) with widths of central and laterals and positions of each 7th marginal indicated.

Fig. 2. *Striatura* (*Pseudohyalina*) *meridionalis* (station 53). Everted penis, from mount in glycerin jelly; somewhat flattened (especially the spines) by coverglass; outlines of epiphallar opening shown at apex.

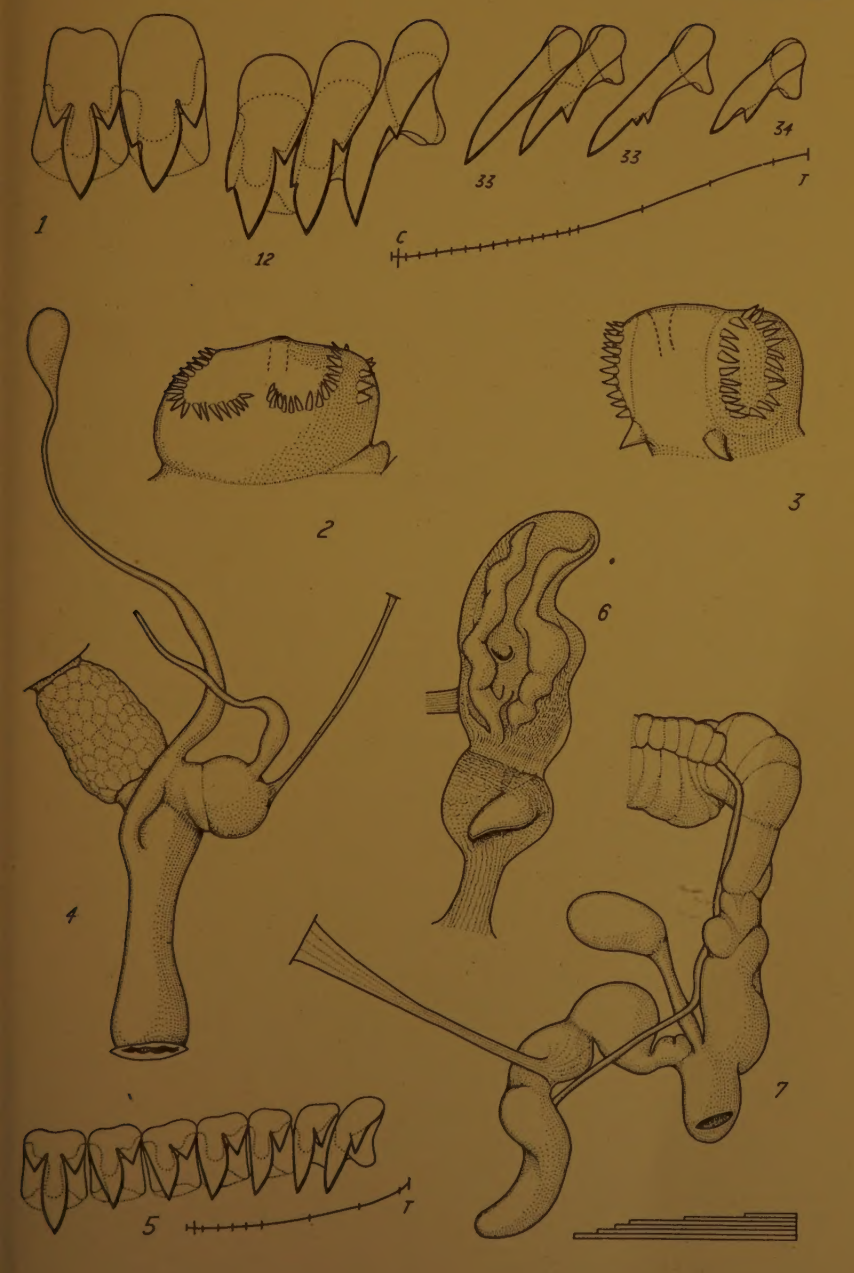
Fig. 3. *S.* (*Pseudohyalina*) *pugetensis* (Clallam Co., Washington). Everted penis, as in fig. 2.

Fig. 4. *S. meridionalis.* Terminations of dissected genitalia.

Fig. 5. *S. meridionalis.* Radula: central and first 6 teeth in natural relations to each other; also diagram of right half of transverse row as in fig. 1.

Fig. 6. *D. laeve.* Penis, cut open longitudinally and pinned out; opening of vas deferens shows as crescent near middle of flagellum.

Fig. 7. *D. laeve.* Terminations of hermaphroditic genitalia; penis pinned out to show full length.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